Trends, Implications and Policy Support Mechanisms

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Acronyms

Acronym	Description
A	
ADB	Asian Development Bank
AER	Assembly of European Regions
AER-CERD	Assembly of European Regions, Committee on Economy and Regional Development
C	
CAFE	Clean Air for Europe
CCD	City Cluster Development
CCICED-TEMP	China Council for International Cooperation on Environment and Development - Taskforce on Eco-compensation
CEC	Commission of European Communities
CHP	Combined heat and power (cogeneration)
CNU	Congress for the New Urbanism
CO	Carbon monoxide
CO2	Carbon dioxide
D	
DoT	Department of Transport (USA)
E	
EC	European Commission
EC-DGRP	European Commission, Directorate General for Regional Policy
EC-EACI	European Commission, Executive Agency for Competitiveness and Innovation
EEA	European Environment Agency
EGCA	European Green Capital Award
EIA	Environmental Impact Assessment
EIU	Economist Intelligence Unit
EQS	Environmental quality standards
ERDF	European Regional Development Fund
ESF	European Social Fund
ESPON	European Spatial Planning Observation Network
EU	European Union
EWEA	European Wind Energy Association
F	
FAR	Floor area ratio
FYP	Five-year plan
G	
GDP	Gross domestic product
GHG	Greenhouse gases
GNI	Gross national income
I	
ICT	Information and communication technologies
IEA	International Energy Agency
IOSC-PRC	Information Office of the State Council – People's Republic of China
ISOCARP	International Society of City and Regional Planners
ITI	Integrated territorial investment
ITS	Intelligent transportation systems
L	
LCC	Low-carbon cities
LCP	Large combustion plants
LEED	Leadership in energy and environmental design
LEED-NB	Leadership in energy and environmental design for neighborhood development
LFP	Local Financing Platforms

LRUS	Large Regional Urban Systems

M

METREX	Metropolitan exchange (a non-profit organization)
MGI	McKinsey Global Institute

N

NEC	National emissions ceilings
NGO	Non-governmental organization
NH3	Ammonia
NMT	Non-motorised transport
NO2	Nitrogen dioxide
NOx	Nitrogen oxide
NREAP	National Renewable Energy Action Plans
NU	New Urbanism

O

O3	Ozone
OECD	Organization for Economic Co-operation and Development
OECD-CDRF	Organization for Economic Cooperation and Development - China Development Research Foundation

P

PASHMINA	PAradigm SHifts Modelling and INnovative Approaches
Pb	Lead
PES	Payment for environmental services
PM	Particulate matter
PSP	Private sector participation
PRC	People's Republic of China

Q

QoL	Quality of Life

R

RBD	River basin districts
RBMP	River basin management plans
R&D	Research and development
RES	Renewable energy sources
RUS	Regional urban systems

S

SO2	Sulphur dioxide
SOx	Sulphur oxide

T

TDM	Transport demand management
TOD	Transit oriented development
TSP	Total suspended particles

U

UNEP	United Nations Environmental Programme
UNEP-CSIRO	United Nations Environment Programme - Commonwealth Scientific Industrial Research Organization
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific

W

WB	World Bank
WEC	World Energy Council
WFD	Water Framework Directive
WHO	World Health Organization

PART I - TRENDS AND IMPLICATIONS

1. Urbanisation: key issues, challenges and priorities • by Luis Balula and Olivia Bina

Given the nature and objectives of WP4: *Infrastructure and services for sustainable urbanization: trends and policy support mechanisms*, we have sought to compare trends and challenges in China and in Europe, and identify policy implications and support mechanisms for decision-making (indicators, paradigm shifts and scenarios). Today, there is no doubt that these two major world regions stand at very different stages of development and 'urbanisation' – an expression which we use to refer to a condition (the share of total population in cities), a planning process (which determines the way cities are built), and a social process (whereby societies become more urban). However, we have learned through our work that these regions share more commonalities than differences, and that there is significant scope for joint research and collaboration in the search for pathways to sustainable urban futures.

In the sections below we summarize the state of the art scholarly and policy literature reviewed on the urbanisation related core themes of WP4 (fully developed on the previous deliverable D4.1) both for China and the EU. These themes are: (a) planning policy mechanisms and urban form; (b) pollution, air quality and related health and economic implications; (c) urban infrastructure and services; and (d) funding regimes. Finally, we identify some critical goals and challenges that are shared by both regions.

1.1 Europe

A. Urbanization

Urbanization and Sprawl

Even though recent trends indicate a deceleration in the pace of urbanization in Europe, most European cities are now experiencing the environmental, social and economic externalities of urban sprawl. The negative impacts of this are felt both within cities (e.g. decaying city centers, road congestion, high energy consumption, pollution, spatial segregation and social exclusion) and in the surrounding rural and natural areas (e.g. loss of agricultural land, depletion of natural resources and ecosystem services). Because cities do not exist in isolation of their wider functional regions, tackling sprawl requires a shared regional vision, policy integration and inter-governmental coordination.

Urban planning / Regional planning

Traditional models of city planning are no longer adequate to manage the complexity of European city-regions. New centralities have emerged in metropolitan areas' hinterlands, shaping a new kind of peri-urban multi-functional territory, and the regional scale plays an increasingly critical role in the implementation of sustainable urbanization policies. Functional urban regions are new geographical realities that require new styles of planning and governance that take into account the regional economy as a whole. This implies an effort to overcome interurban competition and jurisdictional fragmentation, and the adoption of polycentric models that take into account current urban dynamics and the multiple urban-rural linkages of functional regions.

Low-carbon cities (LCC) and Eco-cities

The concepts of LCC and eco-cities are still elusive. What is certain is that cities are open and dynamic ecosystems, which interact with other ecosystems; in that sense, biodiversity is a precondition for urban resilience. Because a city's ecological footprint is strongly determined by urban form, urban design and biodiversity concerns should be better integrated into spatial planning instruments. Smart growth policies, implying integrated transport and land use planning, among other principles, have the potential to bring in many environmental benefits, but remain an exception. Key areas where regional policies are more likely to contribute to low carbon cities are: spatial planning policies; compact city strategies; urban-rural strategies; local energy generation; and transport.

B. Pollution, health and economic implications

The quality of the cities air, water and soil is determinant for human health as well as for that of ecosystems. Pollution poses it at risks as it is widely recognised by citizens and policy-makers. From 1997 to 2008, 13% to 62% of Europe's urban population was potentially exposed to concentration of air pollutants above the EU air quality standards. Road traffic remains the main source of air pollution in urban areas, followed by industrial, commercial and residential sources, while transport is responsible for a significant proportion of human exposure to noise. The economic and social costs of pollution are great in the EU and especially air pollutions pose a major environmental risk to health. Of main concern is long-term exposure to particulate matter (PM_{10} and $_{PM2}$.5) and ozone. Airborne pollutant impacts on soil and freshwater resulting in their acidification, with severe consequences on biodiversity preservation. In recent years, the interrelation between air pollution and climate change has been increasingly recognised and the need to develop more coherent and integrated policies at European level has emerged. A wide range of legal instruments have been approved by the European Union in order to reduce the harmful effects on human health and the environment. The approach adopted by EU to reach this goal is twin-track: establishing limits and targets for air quality concentration; and implementing air pollution-reduction measures such as vehicle emission standards.

C. Urban infrastructure and services

Transportation

Mobility (movement between places and speed of travel) is fundamental to the economy and society, and the degree of mobility of people and goods depends on the efficiency of transportation systems. On the other hand, accessibility (proximity to goods, services and activities) integrates mobility and land use, while promoting non-motorized modes of transport (walking and cycling). Transit oriented development (TOD) strategies aim at both improving intra-regional mobility and increasing local accessibility, and should be more efficiently linked to regional development policies and plans. Sustainable mobility plans, covering whole metropolitan conurbations, have been recently advocated at EU level as a way to promote an integrated approach to transport in cities and towns, as well as in the surrounding rural areas. Intelligent transport systems (ITS) and alternative solutions such as car-sharing, car-pooling and park-and-ride facilities have been implemented to encourage and support lifestyles less dependent on the car.

Energy

The European energy sector faces many challenges, such as the fast depletion of fossil fuels, increasing fuel prices, rising emissions of GHG and the need to upgrade obsolete infrastructure. Energy efficiency is a key point of the European strategy for 2020 and should be mainstreamed into all relevant policy areas, namely the building sector, the transport sector, and the processes, products and industrial infrastructures. On the other hand, energy security requires a diversification of fuel types and supply sources, as well as a reduction in energy imports. By 2050 the EU expects to replace many thermo-nuclear and coal powered plants by a network of renewable energy plants, as

well as the implementation of transcontinental corridors for the transmission of renewable energies. Contrary to conventional energy, renewables are produced close to the source (very often in remote areas). From the standpoint of functional regions, this involves an investment in local and regional energy networks based on endogenous resources. Regional portfolios of renewable energy sources (RES) provide a helpful instrument for vertical integration in the scope of the newly devised National Renewable Energy Action Plans, mandatory for all EU Member States since 2010.

Water

The perception of water as a cheap, unlimited resource is changing; increasing water scarcity is turning it into a valuable resource. Water quality is essential for economic development, human well-being and ecosystem biodiversity. Pressures on European water ecosystems originate in pollution, physical alteration of water ecosystems and overexploitation. Major drivers of such pressures are industry, households, agriculture, navigation, hydropower and urban development. Despite some progress in municipal wastewater treatment, diffuse pollution from nitrates in agriculture and chemicals in industries continues to be a major threat for EU water quality. A mix of policies is needed to address water challenges: water policies require a better integration with agriculture, energy, and land use policies. Because water has a transboundary character, its sustainable use and efficient management also requires the demarcation of transmunicipal river basin districts. Competing uses of water (for agriculture, energy, urban supply and industry) on each river basin and aquifer must then be coordinated in an integrated manner through River Basin Management Plans. Payment for environmental services (PES) is another instrument that can be used to protect and preserve watersheds.

Natural resources

Natural resources provide valuable ecosystem services, but they are still treated as free commodities, as if their supply were unlimited. A perceived scarcity of resources, however, is raising the market prices of some commodities. Resource efficiency is essential for Europe at many levels. There has been some progress in resource efficiency, but the true costs of resources use and associated environmental impacts are not internalized on the final market price of most products. This trend is further distorted by environmentally harmful subsidies that reinforce unsustainable practices and discourage environmentally-friendly business practices. The natural resources policy landscape in the EU is still dispersed and uncoordinated, resulting in fragmented and incoherent policy responses, and most countries do not have a dedicated strategy for resource efficiency. The roadmap for resource efficiency is an all-inclusive framework for policy integration: it encompasses ecosystem services, biodiversity, water, air, land and soils, marine resources, energy and mobility – linking, in addition, these spheres of action to issues of governance, monitoring and funding. To improve resource efficiency is one of the seven flagship initiatives of the Europe 2020 Strategy.

D. Funding regimes

European Regional policy (or Cohesion policy) financing is channeled through three major funding mechanisms: the European Regional Development Fund (ERDF); the European Social Fund (ESF); and the Cohesion Fund. A new proposal for the next Cohesion policy financial framework (2014-2020) is currently under discussion at EU and Member States' levels. The proposal includes ambitious plans to allocate more funds for cities; support the strategic coordination of urban policies across sectors; and encourage innovation by the cities themselves. In line with the proposal, strengthening the role of cities also means to reinforce their integration with the rural areas around, in the scope of functional regions.

A first round of consultation with mayors of diverse European cities, part of a larger discussion process, took place in February 2012. Mayors expressed their views on the new Cohesion policy proposals for 2014-2020, which can be summarized on the following points:

- Flexibility and simplification of funding instruments is necessary
- Delegation of more power to the cities is needed
- ITI - integrated territorial investment is welcome
- Proposed level of funding seems to be insufficient for the objectives
- Innovation has many fields, so flexibility in the use of funds is vital
- There are other financial instruments that can be coupled with Cohesion funds

In addition to EU funds, national and regional governments need to collaborate with cities to help them become more sustainable. There is also room for innovative funding schemes and partnerships that can attract investments from the private sector.

1.2 China

A. Urbanization (urban form and planning policy mechanisms)

Urbanization

Urbanization is the comprehensive theme that encompasses all the others. Urbanization is, and is intended to remain over the next decade, the main driver of China's economic growth. Major concerns, however, arise from the externalities and diseconomies of urbanization, most of which are linked to the dispersed model of urban growth that cities have been predominantly following so far, and which is expected to intensify. Centripetal and centrifugal forces combine, leading to the formation of large regional urban systems. Research priorities should focus around issues of efficiency and size of metropolitan areas, and of public and private investment of infrastructure and services. An understanding of the novel concept of 'functional region' recently advanced by international organizations and urban scholars, and an exploration of its potential application in China may lead to a new planning paradigm for the holistic development and efficient governance of large metropolitan regions, including rural areas, helping to combine multi-sectoral and multi-level approaches.[1]

Sprawl

Sprawl, or extensive fragmented development, the spatial result of the current dispersed model of urban growth, is responsible for uneconomic overextension of infrastructures and services due to leapfrog development, rapid loss of arable land, road congestion and increasing pollution. Research priorities should address land-use and transportation issues, as well as policies and best-practices to control urban sprawl.

Land use

Land use has been managed in less than efficient ways. Inefficient patterns of land use increase the externalities of sprawl (energy waste, congestion, pollution, and human time lost). The use of zoning—a modernist practice acknowledged today in western countries as a planning liability—is widespread in China. Among many other problems, zoning (large mono-functional areas of specialized uses) promotes spatial segregation and aggravates socio-economic disparities. Research priorities should look into urban land use efficiency (e.g., spatial planning techniques, suburban restructuring, improving connectivity, brownfield redevelopment).

[1] Investigation on functional regions can eventually work as a framework (conceptual as well as geographical and spatial) for WP4's further study of the substantive issues of infrastructure and services for sustainable urbanization.

Urban planning, physical planning and urban design

Urban planning, physical planning and urban design are normative disciplines that will play a vital role in China's future. Urban form has a strong impact on urban mobility, energy use and GHG emissions. Conversely, the environmental impacts of urban form can be controlled by design. Meanwhile, new players and new forms of engagement in planning processes are emerging in China, which suggests the need for new forms of urban governance. Research priorities should engage in understanding the ways in which TOD, New Urbanism, and Smart Growth principles could be translated and applied in the Chinese context. This could be done with reference to the "functional region" framework, as briefly described below.

Low-carbon cities and Eco-cities

Low-carbon cities and Eco-cities are powerful metaphors for urban sustainability. However, it seems that in practical terms they have been little more than that. Unsustainable, large scale, urbanization continues to take place at very fast speed in China and yet, despite recent governmental announcements showing some concern with the environment, there is no clear policy to tackle the problem of urban carbon emissions. Research priorities should try to develop the 'case' for the LCC model and develop measures for its implementation.

B. Pollution, air quality, health and economic implications

Pollution, climate change and the environment

Pollution, climate change and the environment are part of one and the same system. Besides water pollution (see above), and the rising levels of solid waste, air pollution (especially NO, SO2 and CO2 emissions) is a very serious problem in Chinese cities – and one that has attracted significant national and international media attention; emissions of air pollutants are expected to rise, with harmful consequences for human health and economic productivity. The quality of air indoors and of air conditioning systems is also a health concern. Health implications are, in turn, linked to the highly sensitive issue of unequal distribution of benefits (and costs) of economic development: a theme often discussed under the label of environmental justice in the USA and in western countries. It is thus indispensable to improve the energy efficiency of buildings and transportation systems, as well as enforce more stringent industrial pollution regulation in order to reduce emissions, mitigate climate change, and reduce health impacts. Research on this theme should be closely related to the research on the key themes of urbanization, transportation, energy, water, natural resources, and public health impacts (and their policy solutions).

C. Urban infrastructure and services

Transportation

Transportation represents today a serious challenge to Chinese cities' sustainability. Rising car ownership is increasing the consumption of energy, accelerating environmental degradation and causing health problems, while road congestion is hurting the economy. There is little mobility to and from suburban areas, suggesting the need for large investments in mass-transit infrastructure. Concurrently, the strong tradition of non-motorized mobility in China seems in need of encouragement, while issues of social equity in mobility and transport are now entering the agenda. Transport demand management (TDM) policies are necessary but not sufficient: in order to be sustainable, urban transport needs to shift the focus from mobility (movement) to accessibility (access to goods, services, and activities). Research priorities should explore current and projected transportation infrastructure investments (both mass-transit and roads), clean or 'zero emission' fleets, non-motorized mobility and intelligent transportation systems (ITS). Transit-oriented

development (TOD) links transportation issues with the themes of land use and low-carbon cities; evaluating the applicability of this model to the Chinese city seems essential.

Energy

Energy demand is soaring in China (and expected to double between 2015 and 2025). The housing and transportation sectors are the main drivers of this demand, and the expected rate of growth on both sectors requires sturdy investments in renewable energies. There has been some progress in energy efficiency, but there is still a lot to do. The supply must evolve away from coal and the existing plants need to improve their efficiency. The energy market is evolving but needs further improvement. While the housing sector is a strong driver of energy demand, there are serious issues regarding the embedded waste of energy, resulting from the poor quality of buildings. Construction standards should be more firmly implemented, as buildings must meet energy-efficiency criteria (regarding insulation, windows, heating and cooling systems, etc.) as well as improve the quality of materials and construction techniques. The transportation sector is the other major driver of energy demand. Smart urban planning can make the difference and significantly cut energy demand. Research priorities should address energy supply and demand of renewable and non-renewable sources, mechanisms to reduce demand, as well as issues related to energy-saving standards for buildings (e.g. LEED) and for whole neighbourhoods (LEED-ND).

Water

Water supply in Chinese cities faces severe quality and quantity issues (demand is expected to increase by 70-100% by 2025). Water shortages are common and, due to pollution and a lack of adequate sewage and solid waste treatment facilities, the quality of drinking water is frequently below international potable standards, which poses serious threats for public health. Recent outbreaks of illnesses, including cancers, associated with the consumption of heavily polluted water, as well as frequent water-related environmental disasters are spurring social unrest. Moreover, constraints on water supply are hurting the economy. Wastewater treatment facilities in China are mainly geared towards pollution prevention and not towards recycling and commercialization of treated water (an untapped resource). Water resources management is dispersed by too many agencies at all levels of government, and water laws are outdated, weak, and scantily enforced. The main driver of demand is agriculture followed by residential and industrial usages. Research priorities should focus not only on water supply and demand (in these three sectors), including new approaches such as desalination, but also on the requirements in terms of wastewater and solid waste treatment facilities., and a better understanding of energy-water interactions, such as the embodied requirements of hydraulic infrastructure.

Natural resources

Natural resources are finite resources, and their fast depletion, either due to the demands of urbanization, or to its externalities (e.g., pollution, waste) results in the loss of essential ecosystem services. Fast increases on resource extraction and material consumption (partly driven by urbanization trends), are putting pressure on global resource reserves and ecological capacities. Depletion of natural resources is also associated with social inequity. If natural resources are to be envisioned as “natural capital” a market-based policy approach could turn out to be a key corrective measure (as advocated, inter alia, by various United Nations agencies), for as long as there is no market for ecosystem services, private entities and governments are free-riders who consume natural assets without meeting externality costs, or the costs of sustainable management of ecosystems. The Chinese leadership is aware of these facts. However, improved regulation and incentives are greatly needed for a better management of natural resources such as water, soil, fossil fuels, forests and biodiversity. Research priorities should address environmental protection/ conservation policies, with a particular focus on how resource management affects the quality of life

in urban areas and surroundings, taking into consideration the interests of both present and future generations.

D. Funding regimes

There are multiple financing sources for urbanization in China: (i) central government funds; (ii) transfer payments from central government; (iii) public finance expenditures from central government; (iv) public finance expenditures from local government; (v) local government debt; and (vi) funds from non-state-owned enterprises. Funding for Central and Local Governments' investments can also be leveraged through National Bonds, Local Financing Platforms (LFPs) or obtained through capturing private (often non-Chinese) investment capital. China has a relatively centralized fiscal system (since 1960 central government revenues have accounted for more than 40% of total government revenues), although incremental changes have taken place over time. Local government revenue consists of taxes and other sources, such as fees and revenues from land sold to real estate developers. Government expenditures on community services is still low and both at local and national levels, governments have been slow at implementing a budget for environmental protection.

1.3 Shared goals and challenges

In conclusion, traditional planning models are no longer adequate, and each region is struggling to find answers to problems both old and new: sprawl and dispersed models of urbanisation combine with rising negative externalities and diseconomies (including pollution and road congestion) as the headline challenges in China; these combine with issues arising from zoning, complex multi-functionalities, scale (city-regions and peri-urban developments) and jurisdictional fragmentation – to complete the picture of urbanisation trends and challenges in Europe as in China. The limitations of current planning models are exacerbated by urban form and urban design practices, which often provide only partial (narrowly defined) solutions, and are likely to create new problems even while solving others. For example, the costs of failure to consider and include ecosystem services and biodiversity benefits and needs in urban planning and design are increasingly evident, both in relation to infrastructure and services, and more generally in terms of land-use. Better integration of planning and design emerges as (and in Europe: *continues to be*) a need and priority.

'Scale' is an especially interesting interpretative lens through which to identify and examine some of the multifaceted challenges of urbanisation arising from the literature reviewed. In China in particular, *scale* of urbanisation combines with *speed*, thus exacerbating trends and problems otherwise relevant to both European and Chinese regions. We identify four sets of issues that can be grouped under the heading of 'regional scale' issues, and that - to varying degrees - affect both areas: (1) the interface between Europe's urban agenda and regional development and cohesion policy (and related development funding for infrastructure and other relevant investment sectors), and between China's overall macro-economic priorities and its planning and targets for urbanisation; (2) the economic and resources competition in inter-urban context, the interdependent and dynamic nature of ecosystems management (in particular water), the rules - or lack thereof - for ecosystem services payment, and related European and Chinese river-basin planning rules; (3) the multiple functions and urban-rural linkages, requiring new governance and socio-technological solutions to better integrate the planning and design of infrastructure for the exploitation and management of water, energy, land and agriculture; and (4) the rising reference to urban ecological footprints as a way to capture some of the negative impacts of issues (1) to (3).

More in general, the review of academic and policy literature reveals that the significant problems resulting from past and current urban planning and design models are converging towards the common (we could even say ubiquitous) goal of 'greater efficiency'. Efficiency in the extraction, management and disposal of resources (notably energy and water); efficiency in avoiding and, or, solving pollution; efficiency in the planning and governance of interdependent infrastructures and services (notably transport), and of competing land-uses.

Bearing in mind the focus on infrastructure and services of WP4, we identified four categories of efficiency-driven propositions across Europe and China: (1) Land-use related efficiency includes proposals for 'smart cities', the well established ideas of 'new urbanism', of 'compact cities' and the pursuit of 'urban-rural strategies'; (2) Transport related efficiency is closely linked to category 1, and includes proposals for 'transport oriented development' – TOD – strategies, 'intelligent transport systems' – ITS, and 'whole lifecycle' propositions; (3) Energy related efficiency – also linked to category 1 – includes the proposal for 'smart cities', 'low-carbon' cities, and 'local' energy generation; and (4) Ecologically related efficiency, that has been driven primarily by ideas of 'eco-cities'.

As efficiency takes centre stage in almost all debates, and in relation to virtually all urban challenges in China as in Europe, a question remains: how to ensure urbanisation (as a condition and process) is socially, environmentally and economically sustainable? This question is crucial, not only for its inevitable appeal to the well-established arguments about the limits of efficiency (for example 'Jevons Paradox', Bina and La Camera, 2011); but also for the persistent difficulties in re-uniting what has been systematically divided (at times for the benefit of efficiency) into sub-sectors of the urbanisation process. Both China and the EU offer abundant examples of similar difficulties.

Better integration of all these issues into planning and design *continues* to be a priority. In Europe and more broadly at the OECD level, one of the interesting propositions being made to help address them is the geo-administrative notion of 'functional regions', which we develop in the next Chapter.

2. Urbanization in China: Impact on sustainability – 1970s to date •

by Ma Zhong, Craig Hart, Qi Xiaoxu, Yang Zhiyou, Xiao Wanting, Wang Tianyu

Ever since China's reform and opening-up policy implemented in 1978, China started its urbanization process, which has accelerated dramatically in the recent past. With continually adjusting and improving development strategy and reform policy, China has made remarkable progress towards meeting its urbanization goals. Statistically, the national urban population increased from 173 million people in 1978 to 690 million in 2011, exceeding the global average of approximately 53% of the world's population living in cities. In 2011, the urban population exceeded the rural population for the first time in China. The urbanization level rose from 17.92% up to 51.27%. The number of cities[2] increased from 193 in 1978 to 657 by the end of 2010, forming a certain number of internationally influential urban agglomerations such as the Circum-Bohai-Sea region, Yangtze River Delta and Pearl River Delta metropolitan areas. In order to support urbanization, urban infrastructure and utility service capacity have improved significantly. As a result, living standards and the living conditions of residents have gradually improved. National urban development zones[3] extended from 7,438 km2 in 1981 to 30,138 km2 in 2011. Per capita housing area increased from 6.7 m2 in 1978 to 36m2 in 2011. Per capita annual disposable income in urban areas was RMB 343 in 1978 and RMB 21,810 in 2011. During the period of the 11th 5-Year Plan (2006 to 2010), China added a total of approximately 663,000 kilometers of urban road network.

However, behind all the great achievements in urbanization development, China is also facing numerous challenges. Among them, the sustainability of urban development has widely drawn attention. China's cities consume renewable and non-renewable resources to support productive and household activity. Irrational or excessive use of resources has resulted in waste and environmental damage. Natural resource availability will inevitably represent a constraint to sustainable urban development. Moreover, water, land and energy are important material bases of urban development. The availability of natural resources (water, land, etc.) on a per capita basis reveals that China faces relative scarcity. Meanwhile, the trend towards building low-density suburban development in the Western style on the edges of high density urban areas coupled with urban population growth presents serious problems. The potential consequences may include over occupation of national territory, excessive reduction of arable land and other threats to national ecological environment. Therefore, a focus on sustainability is the inevitable choice of China's urbanization development.

This report deals with China's urbanization process and its impact on China's sustainability. It sketches the current situation of China's urbanization highlighting major issues, and then offers suggestions on future development strategies at the national level. The current state of the urbanization process will be described across 5 areas: society, economy, ecological environment, energy system and infrastructures. The influences on society are derived from the changes in population, education, culture, the health system and social assistance. The economic situation is illustrated through national industrial structures, government financial statistics, and labor and employment rates. From the studies on the current situation, 5 major urban environmental issues are summarized and analyzed. The last section of the report formulates recommendations at the strategic level.

[2] According to China Bureau of Statistics, the city classification standard is scaled as follows: urban resident population of 500,000 is a small city; 500,000~1 million for a medium-sized city; 1 million~3 million for a big city (metropolis); 3 million~ 10 million for a super big city (megalopolis); and more than 10 million for a giant city.

[3] Urbanized area in China nationwide

Concurrent with China's rapid economic growth, China's urbanization process has accelerated dramatically in recent years. The national urban population increased from 172.45 million people in 1978 to 690.79 million in 2011, reaching the global average of approximately 53% of the world's population living in cities. Thus, in 2011, the urban population exceeded the rural population for the first time in China,[4] representing a major achievement for national urbanization policy. Notwithstanding its success, China is still facing numerous challenges in urbanization development. Among them, the sustainability of urban development remains a major issue and potential stumbling block for China's future development. Inefficient use of resources and excessive emission of pollutants, combined with a pattern of low-density urban development and urban population growth, present serious environmental challenges. The potential consequences include excessive and inefficient land use, reduction of arable land which threatens food security, and inefficient use of resources which poses potential threats to China's environment. Hence, seeking a sustainable path for urban development must become a priority for China and become a central theme in environmental protection.

Further urbanization remains a main policy goal of China's government. However, urbanization targets overlook serious societal problems. One of these problems is how to make effective policies to better integrate rural migrants with urban society. Rural labor has contributed enormously to the construction of urban areas and yet they often find themselves marginalized in the new urban society. Avoiding irrational and unplanned city expansion should also be a priority for local governments. As noted above, this is essential for efficient use of resources. Finally, urban crowding, transportation congestion and air pollution have transformed the nature of Chinese cities and adversely affected the quality of life. Greater attention is needed to address these "soft" aspects of urbanization that nevertheless have a profound impact on living standards in China's cities.

Importantly, in March 2014, the central government released a national urban strategy to better manage the flow of immigrants from country to cities and the resulting quality of life challenges that result. Specifically, the policy emphasizes:

- reasonable migration to promote agricultural population transforming into urban population based on "People oriented Urbanization ";
- Innovative urbanization as a multi-faceted concept involving population, land, capital household, and industry, rather than simply as a means to increase GDP. Also, industrialization does not specifically refer to development of secondary industry, but rather should promote the appropriate mode of industrialization based on the endowment of the city.
- "Ecological civilization" thinking should be considered in urbanization and promoting green development and low-carbon development, including recycling in consumer and urban settings.
- Build a scientific and rational macro urbanization plan according to the carrying capacity of natural resources and the environment, and seek to improve the efficiency of land use based on an integrated transportation network and information network.
- According to the natural, historical and cultural endowment of different regions, establish a "beautiful town" designation reflecting regional difference in order to promote distinctive urbanization development models.

Urbanization policy alone cannot address all problems associated with the transition to an urbanized country. Other policies such as labor, social insurance and medical insurance, and housing policy reform also must be considered. For example, workers in China's cities that do not possess

[4] Online national database established by National Bureau of Statistics of People's Republic China. (http://data.stats.gov.cn/)

legitimate or formal contracts often suffer from inability to obtain pension insurance, because such insurance only covers residents with labor contracts, according to current laws. How to improve the related policies should be prioritized by the government. Another issue with the pension insurance system is that China's pension insurance fund gap has become increasingly large, raising issues as to how to fund it. Policy suggestions of postponing retirement ages and "House-For-Pension" (refers to reverse mortgage) have been brought up.

Whether employed or unemployed, urban or rural, all citizens should be eligible to join the medical insurance system according to China's laws. However, owing to insufficient public expenditure on such issues and high costs for medical insurance, low-income residents face hardship in obtaining insurance and often are uninsured. Considering that the medical insurance system is tightly related to the urban residents' health and life quality, and is therefore crucial in urbanization development, the government-paid proportion of residents' medical cost should be further increased.

The ever-rising prices in the urban real estate market have become a major issue in China's urbanization, especially in the middle- and large-sized cities. To solve such a problem, both the local and central governments are trying to establish policies for cooling the market and reducing residents' housing pressure, including increased supply of low-income housing, development of employer-sponsored funds to assist employees in purchasing homes, restrictions on housing purchase, macroeconomic regulatory, etc.

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With the steady growth of China's GDP for over 20 years, agriculture accounts for a smaller and smaller portion of the GDP while the tertiary sector continues to increase. China's growing tertiary sector is reflected directly by urbanization trends as numerous rural migrants quit farming to seek jobs in the cities. It should also be noted that the share of secondary industry is constant, implying that China's urbanization is still in an early stage, as industrial activities still serve as a key impetus for China's development. This results in enormous environmental costs. Faced with the double pressure of expanding the economy and realizing the industrial structural transformation, China has expanded government investment, further opened domestic markets as well as supported the development of hi-tech industries.

China's government set the goal for 2013's economic growth at 7.5% and is aiming for a GDP per capita double the amount of that of 2010 in 2020. While modest by China's historical growth, this still represents relatively rapid growth that better balances environmental impacts. Due to the revision of the statistical standards of the fiscal revenues and expenditures of China initiated in 2007, it is hard to interpret the general trend and impacts on urbanization in this area based on the available data. Nevertheless, it is evident that China has been running a financial deficit in recent years, which is directly related to the 2008 global financial crisis and its aftermath. China intends to make use of the multiplier effect of governmental expenditure for economic development and the massive "4 Trillion RMB Stimulus Package" initiated in 2008 is considered as a very representative policy, the effects of which are yet to be seen and evaluated.

As mentioned, China faces critical challenges in all aspects of the ecological environment during its process of urbanization. China's emphasis on rapid growth over the past three decades, its reliance on coal, and weak enforcement mechanisms have all contributed to the problem. In recent years, public awareness is raising the profile of China's environmental problems, placing pressure on government at all levels to find solutions, which also requires the government to improve information disclosure and decision transparency related to environmental issues.

Ever since 2007, the total area of land requisition for urban construction had been ceaselessly increasing for 5 years[5], indicating a steady growth of China's urbanized area. Even though the population density in China's major cities has been increasing sharply, the nation's overall urban population density remains rather stable, which likely results from newly-developed urban areas with rather small numbers of residents. Considering that there should be sufficient land preserved for agriculture to ensure food security, the expansion of cities is not without limits. Hence, the government should plan for newly-constructed cities for sustainable urbanization considering all the above restrictions.

Major policy challenges face China's policymakers in meeting environmental goals in the face of urbanization. The vast majority of the 113 cities for which environmental standards have been developed have failed to satisfy the new environmental standards on air quality (GB3095-2012) including additional standards for $PM_{2.5}$ and ozone and more stringent standards for several other pollutants including PM_{10} and NO_2. This suggests that although local governments are taking sustainability development into consideration in planning, the commitment to true sustainability remains unclear. Local governments should realize the long-term potential harm to environment and sustainable urbanization generated by an excessive proportion of secondary industry in local economy, besides its short-term benefits; hence more policies concerning industrial adjustment and energy efficiency improvement should be introduced.

As for urban water pollution, the available data clearly show that even though the compliance rate of industrial waste water discharged is continuously rising, the volume of industrial waste water discharged didn't overtly diminish, making the multiplied effect (pollutant concentration multiplied by total volume of waste water) quite serious, especially within China's relatively loose environmental standards. Since pollutants accumulate in the water and are hard to degrade, the duty on local governments to preserve urban water quality is quite heavy. More stringent regulations and accompanying enforcement is eagerly anticipated.

Benefiting from the operation of West-East Gas Transmission Pipeline No. 2 started in 2010, many cities in China initiated plans for conversion from artificial coal gas to natural gas (mostly in households). Hence, it is evident that the household energy consumption is turning more and more environmentally friendly in China. However, the conversion is mainly focused on the residential sector, while the industrial demand for coal is still markedly rising, which should be accordingly prioritized by local governments. Although the proportion of natural gas has been consistently rising, its net share is still insignificant compared with that of coal. Despite a lack of urban data on such issue, it can be safely estimated that achieving a clean urban energy system still requires significant efforts.

In many cities of China, household solar water heaters are now rather common, showing a good sign for the development of renewable energy in urbanization. However, there are also concerns in the field of renewable energy. For example, in some cities relying on hydroelectricity, consequential ecological problems such as soil desiccation and biodiversity shrink have been triggered. Therefore, local governments ought to conduct thorough environmental impact assessment before approving any such project.

China is in a period of rapid urbanization development, and urban population, resources and energy consumption will accordingly continue to grow. Both the local and central government must play a leading role in the future development decision-making process, adjusting the urban economic, social development and environmental imbalances. We conclude this report with some specific policy-making suggestions:

- Accelerate the construction of urban environmental infrastructure;

[5] Online national database established by National Bureau of Statistics of People's Republic China. (http://data.stats.gov.cn/)

- Implement urban environmental management guidance, and promote the integration of environment and economy;
- Implement regional joint pollution prevention and control, and improve regional urban environmental quality;
- Develop the circular economy, and accelerate the construction of environmental friendly urban society;
- Rely on the urban communication platform, establish and improve the environmental information propaganda system and public participation mechanism.

The central government's 2014 National Urban Policy is a step in the direction of better managing urbanization, and will help place greater emphasis on the environmental aspects of urbanization. How this policy is implemented in practice will define its impact. Further steps of changing industrial patterns and strengthening coordination and regulation among government agencies is essential. We therefore believe that deeper structural change in terms of China's industrial and government enforcement is essential to guiding urbanization along a sustainable path.

3. URBACHINA's 4 Cities – past and current trends • by Ma Zhong, Qi Xiaoxu, Yang Zhiyou, Wang Yifu, Xiao Wanting, Yang Yueying, Wang Tianyu, Craig Hart

This chapter is an abridged version of the full report, included as ***Annex 2: 4-City Study of Sustainability Trends***

3.1 Introduction

This report provides an urbanization overview of four cities in China: Chongqing, Huangshan, Kunming and Shanghai. The report focuses on the following WP4 themes:

a) Socio-economic characteristics: GDP, population, build-up area, urban area vs. suburban area, urban population vs. suburban cities.
b) Environment: water pollution, air pollution, solid waste
c) Natural resources: land, urban greening, fresh water, wetlands
d) Energy use: fossil fuels (coal, oil etc.), clean energy
e) Infrastructure: transportation, water supply facilities, water treatment facilities, housing
f) Social services (soft infrastructure): educational services, medical services, health care services

The purpose of this report is to provide readers with concrete examples of how urbanization is developing in China in these four cities in order to inform the broader analysis of China's urbanization countrywide. We note that these four cities cannot be taken as representative of all of China. All cities are located in the deep south of China, and all of them are south of the Yangtze River. However, they are representative in other ways. Chongqing and Shanghai represent the largest of China's cities, representing metropolitan areas with provincial status. Kunming represents a medium-sized city in terms of population. Huangshan, in contrast, is a rural district, and it has yet to embark on a full program of urbanization. Further, Huangshan represents how the countryside is potentially affected by urbanization in China.

The main method employed is data analysis and processing. During data processing, we follow an indicator system established on WP4 themes. The selected indicators are as following:

a) Society (total population, urban population proportion, number of medical personnel per 10,000 people)
b) Economy (GDP, proportion of primary/secondary/tertiary industry in GDP, fiscal revenues/expenses, unemployment rate)
c) Ecological Environment (volume of water per capita, forest coverage rate, yearly average of atmospheric SO_2/NO_2/PM_{10} concentrations, SO_2/NO_2/soot and dust removal, wastewater treatment capacity, wastewater compliance rate, accumulated sewage treatment amount, sewage treatment plant operating load rate)
d) Energy System (LPG supply, natural gas supply, hydropower station installed/generating capacity, energy consumption amount, energy consumption per capita/per GDP)
e) Infrastructure (urban land proportion in built-up areas, area of paved roads, number of buses/taxies, property prices)

This report is structured in five main sections. Each city is covered in its own section. Within the analysis for each city, we evaluate the WP4 factors cited above in the order presented based on the data available in our indicator system. Following the city analysis, we summarize our general conclusions and the lessons and questions they raise for the broader analysis of Urbanization in China.

In the case of Huangshan, the Renmin University team conducted in depth analysis of the potential path of urbanization. The full case study is presented in Appendix A to this report. Because we conducted deeper analysis in Huangshan, the Huangshan section of this report is based not only on our indicator system, but also on interviews and engagement with the local government.

3.2 Huangshan[6]

3.2.1 Overview

Huangshan District is located inland of South Anhui with Mt. Huangshan to the south, Taiping Lake to the north and Mt. Jiuhua to the west. It covers an area of 1,775 square kilometers with a population of 161,500 (2012). Its history can be traced back to as early as 1,250 years ago. Huangshan District is famous for its unique location, long-standing history, peerless ecological environment and abundant tourism resources.

3.2.2 Purpose, Scope and Methods

The purpose of this report is to discover the trends of Huangshan District's recent urbanization and to propose a set of more sustainable strategies for the future by evaluating both the obstacles and potentials of the district.

In this analysis, we evaluate the possible path of urbanization in rural Huangshan District from various perspectives relevant to the WP4 themes, specifically economic, environmental and social factors.

Based on reliable data and first-hand information, we assess the optimal urbanization plans for Huangshan District.

3.2.3 Core Issues of Huangshan Urbanization

Existing Issues of Economic Development

i. Industrial Structure

Considering the structure of Huangshan District's GDP, from 2000 to 2012, the primary industry had been falling (from 26.2% to 11.4%) while the secondary industry's share had been rising dramatically (from 17.6% to 40.1%) with the tertiary industry's proportion declining slightly. This conversion is partially due to its accelerated urbanization during recent years which has leaded to shrunken farmland and reduced labor force of farming. Meanwhile, local government intends to develop the secondary industry to boom local economy by other means than its traditional tourism-dominant tertiary industry. However, the expansion of secondary industry is very likely to harm local environment and hence undermine the revenue generation capacity of tourism. Without stringent environmental regulations, chances are that the overall economy of the district will be stagnant in the future and that the local urbanization is unsustainable.

ii. Government Financial Conditions

[6] Except where otherwise noted, all Huangshan District data of 2011 and the years before 2011 in this section are cited from *Huangshan District Statistical Yearbook 2012* by Bureau of Statistics of Huangshan District, Huangshan City, and all Huangshan District 2012 data in this section are cited from *Statistical Communiqué of Huangshan District on the 2012 National Economic and Social Development* by Bureau of Statistics of Huangshan District, Huangshan City, 2013.

In 2012, Huangshan District's financial expenses reached 1,442 billion RMB, with an increasing rate of 26.5% from the previous year. There appears to be various reasons for the district's financial deficit mentioned above, including a lack of stable growth of income sources (due to poor economic planning and irrational industrial structure) and numerous newly introduced policies with incremental expenditure (such as the wage increase of civil servants).

Existing Issues of Ecological and Environmental Protection

i. The Safety Issue of Drinking Water

Huangshan No.1 Water Plant is the main source of drinking water for Huangshan District, serving for both urban and rural areas. It is located on Puxi River in Gantang Town in the district. Zhanggeng Village, located upstream of the water intake, has a large number of farmers with an inefficient pattern of farming using excessive amounts of pesticides and fertilizers, which has become a great threat to the safety of the drinking water sources. Besides, the residential sewage along the river has also become a major source of drinking water pollution.

ii. Environmental Threats of Tourism Development

In recent years, Huangshan District's tourism industry has experienced rapid development. However, this development combined with a lack of overall planning and environmental protection has had a rather negative impact on Huangshan District's environmental carrying capacity. Massive large-scale construction projects will reduce the conserved forest area, change the original ecological environment and destroy the ecosystem's integrity. Otherwise, reception of excessive visitors will result in increased resource consumption and waste emission, further threatening the environment of Huangshan District.

iii. Environmental Threats of Secondary Industry

Since the Eleventh Five-Year Plan, the secondary industry in Huangshan District has been gaining momentum. Industrial parks have appeared and gradually evolved in both area and technology, and industrial output has grown at an accelerating rate. An increasing proportion of secondary industry in the local economy includes printing, copper processing, non-ferrous metal smelting, etc. It should be realized that enterprises engaged in heavy metals, molybdenum smelting, molybdenum chemical, etc. are prone to large-scale environmental accidents, not to mention their routine pollution emission.

Existing Issues of Social Development

i. Loss of Human Capital

It is not difficult to get a job in Huangshan District, nevertheless, a well-paid one is rare to find. Lacking large- and medium-sized enterprises, Huangshan does not have a prosperous job market, even though the local unemployment rate of 3.82% was lower than the national average of 4.1% in 2012. With real estate prices increasing, low-income people are living under more pressure than ever before. If this situation continues, Huangshan District will face enormous loss in human resources, for all levels of labor force are likely to move away.

ii. Education: Improved but Not Perfect

Education is improved in Huangshan District but still not perfect. Since Huangshan is a county-level city, K-12 education resource is relatively equally distributed there. However, the number of students per class is often between 50 and 60, making it very hard for teachers to provide each student with sufficient attention at school. Additionally, afterschool programs are not as diversified and qualified as what their counterparts enjoy in large cities, which possibly means teenagers there lack opportunities to develop various talents.

iii. Wealth Gap

In 2012, the annual net income per capita of farmers in the district was 9,426 RMB, while disposable income of urban residents reached 20,346 RMB, more than twice the former. Unsurprisingly, such wealth discrepancy is partially rooted in differentiated education and family background. Those young people who were privileged enough to attend college in nearby cities and find jobs in Shanghai, for example, can move back to Huangshan having accumulated much more wealth than a high school drop-out farmer boy who is trying to create a better life for himself by moving there too.

Existing Issues in Sustainable Energy

The local government of Huangshan District has not yet come up with any specific development or management plan for renewable energy. Additionally, for the local people, the awareness of the economic and environmental benefits of renewable energy is not high enough. Local energy has not been fully exploited, especially the potential for utilization of biomass energy.

Currently, the main energy source in Huangshan District is coal and other kinds of fossil fuel energy, even though such energy resources are scarce in the district. This makes the district heavily reliant on external energy supply in an unsustainable way. On the other hand, the district is endowed with abundant renewable energy such as hydropower, agricultural bioenergy, forestry bioenergy and solar energy. If these renewable energy resources are to be efficiently exploited, then the district is very likely to save on energy consumption as well as embrace a more harmonious and sustainable environment.

3.2.4 Sustainable Strategies for Huangshan Urbanization

Economic Development

i. Tourism Industry

- Product Diversification

Tourism market evolution requires both fully exploring the potential of existing market and developing new tourism market products. Diversified marketable tourism products are crucial in further development of tourism market. Specifically for Huangshan District, it is important to explore innovative material and service products based on the splendid history and culture of the district.

- Infrastructure Development

Municipal infrastructures are essential for a tourism-centered district, for they have to support both local residents and massive inflows of tourists at the same time. In order to further develop tourism, Huangshan District should focus on the construction of roads, parks, communication networks, etc. However, attention should be paid to the financial deficit of the district and potential ecological impacts before any new construction project.

- Ecotourism Development

Focusing on environmental-friendly tourism/low-carbon tourism/ecotourism presents a possible opportunity for Huangshan District to preserve its environment and culture as well as make profits from tourism. Making Huangshan an ecotourism destination may attract visitors for its unspoiled natural beauty and sustainable development ideology.

ii. Agriculture

- Ecological Priority

Huangshan District's agricultural development must emphasize the principle of "Ecological Priority" in order to accelerate the transformation from unsustainable agriculture to environmental-friendly agriculture. If excessive fertilizers and pesticides are used by farmers who are unaware of the consequential ecological harm, not only will health hazards be brought by the agricultural products,

but also the farmland will be damaged and unable to make qualified output in the future. Such unsustainable agriculture will eventually impair the farmers' benefits.

- Brand Strategy

Thanks to its superior natural endowment, Huangshan District is able to develop diversified and qualified agriculture including conventional crops, tea, bamboo, etc. If these agricultural products are promoted with elements of Huangshan Districts' unique culture and ecology with brand strategies, the market is very likely to be extended.

Energy and Environment

i. Renewable Energy

- Combination with Ecotourism

As a tourism-based area, it is essential that Huangshan District should develop renewable energy via tourism. As mentioned above, ecotourism can be a feasible path for further development of the district's tourism. Hence, it is reasonable to combine renewable energy policies with ecotourism strategies. For example, solar water heaters should be popularized among all hotels in the district.

- Bio-Energy Development

Since Huangshan District is endowed with abundant ecological resources, various kinds of bio-energy are available including wood-based biomass, livestock manure biogas, etc. Livestock manure biogas should be further generalized in local farms as part of a circular economy. Meanwhile, wood-based biomass can be used to generate heat for local residents in Winter. However, to raise people's awareness of both the economic and ecological benefits of bio-energy and to adopt innovative technologies are vital in popularizing bio-energy development.

ii. Environment Protection

- Pollution Prevention

Huangshan District enjoys a relatively clean environment, however, the environment is currently under threats as local economy flourishes, especially when the proportion of secondary industry in local GDP keeps increasing. Hence, steps should be taken to prevent excessive pollution. In particular, the district should accelerate the project for a developed urban sewage pipe network and water treatment facilities, and meanwhile enhance the monitoring and regulating capacities of pollution emission from local factories. It is also essential to improve solid waste disposal facilities, which is essential to protect scenic spots. Additionally, more stringent environmental standards are anticipated.

- Combination with Ecotourism

Since tourism is Huangshan District's pillar industry, environment protection will not likely to directly restrict its economic development, for deteriorated ecology will harm tourism and trigger severe problem in local economy. Under such circumstances, as mentioned, ecotourism is possibly a wise choice for the district. If environment protection is well combined with incentives to further develop tourism, then the outcome is sure to be more effective.

- Public Education and Engagement

Huangshan District should fully use radio, television, newspapers, Internet and other media to inform the public about environmental facts and to collect residents' opinions. Local government should also spread the knowledge of, and the need for, environmental protection to the people in general, so as to guide local residents and raise awareness of ecological civilization and sustainable development.

3.3 Shanghai

3.3.1 Overview

Shanghai sits at the mouth of the Yangtze River, the longest river in China. It borders the estuary of Yangtze River to the north, Jiangsu and Zhejiang Provinces to the west and Hangzhou Bay to the south. Due to its advantageous geographical location, Shanghai has become a large and prosperous port city. It is the largest Chinese city and "a city of skyscrapers". With a history of more than 700 years, Shanghai was once the financial center of the Far East. Today, Shanghai is the largest economic and transportation center in China. Shanghai also has one of the world's busiest ports, and has become the largest cargo port in the world. The municipal government is working towards building Shanghai into a modern metropolis and into a world economic, financial, trading and shipping center.

3.3.2 Purpose/scope/methods

Shanghai's recent urbanization process begins at the end of the 1970s, when the population was less than 10 million. After more than 30 years of development, Shanghai has already completed its urbanization process. As a pioneer of China's urbanization, Shanghai's urbanization process may? greatly influence other cities' urbanization. Therefore, focusing on the WP4 themes, this section analyzes Shanghai's urbanization trends to reveal its policy implications and possibly serve as a model for other large cities.

3.3.3 Shanghai: Development potential and dilemmas

a) Shanghai's development potential

As the biggest city of China, Shanghai' has good development potential, which could be synthesized in the following aspects:

First, Shanghai's advantageous location provides an excellent opportunity for Shanghai's trading economic. Sitting at the mouth of the Yangtze River, Shanghai has the biggest foreign trade port and the biggest industrial base of China, which enhance the external trade of Shanghai.

Second, Shanghai's opening-up policy makes it attractive to foreign investment. After more than 30 years' opening up, Shanghai has become one of the largest city which has the largest scale of foreign capital, the widest area of investment, and the best foreign investment efficiency in China.

Third, Shanghai's tertiary industry is well developed. With the establishment of China (Shanghai) Pilot Free Trade Zone, Shanghai's financial industry is expected to boom.

In addition, Shanghai's tourism resource is also plentiful, which contributes to the economy development.

b) Shanghai's development dilemmas

High speed economic growth rate as we can see, there are, however, some problems hidden behind the city. Shanghai's development dilemmas can be divided into the following parts:

From the economic aspect, most of Shanghai's emerging industries like new energy vehicles, marine engineering was composited by SOEs, which need more momentum and innovation to develop.

For ecological and environmental protection, Shanghai is lack of natural resource, such as clean water and land, which set another restriction to the development. And Shanghai has some environmental problems such as acid rain, polluted air, polluted water, etc.

As for dilemmas in social development, Shanghai is facing the challenge of aging and population decline. And Shanghai's high house pricing and living cost make it hard for young people to live a life, especially for workers from other province.

c) Shanghai development model and trends of sustainable urbanization

Shanghai's development is benefiting from the opening-up policy and tourism resource. By attracting foreign capital, developing the producing industry, and foreign trading, Shanghai established the fundamental basis of economy. And after that, Shanghai adjusted industry instruction to develop the service economy and aimed at establishing the financial central of Asian.

Shanghai's further development is relayed developing sustainable industries, improving the quality of industries, and forming a innovation-driven economy.

3.4 Chongqing

3.4.1 Overview

Chongqing is situated in the southwestern part of China, at the transitional area between the Qinghai-Tibet Plateau and the plain on the middle and lower reaches of the Yangtze River in the sub-tropical climate zone swept by the moist monsoon. The land under Chongqing's jurisdiction is 470 kilometers from east to west, and 450 kilometers from north to south. It borders on Hubei and Hunan provinces in the east, Guizhou in the south, Sichuan in the west and north and Shaanxi Province at its northeast corner.

3.4.2 purpose/scope/methods

The purpose of this report is to propose development models and trends of sustainable urbanization for Chongqing by analyzing the current situation and seeking feasible solutions to the present obstacles of the district's further urban development.

In this analysis, the possible path of urbanization in Chongqing is evaluated from various perspectives relevant to WP4 themes, specifically economic, environmental and social factors.

3.4.3 Chongqing: Development potential and dilemmas

Chongqing is one of the four direct-controlled municipalities and the only one of its kind that locates in the western part of China. Nowadays, Chongqing is facing the omnipresent benefits and challenge from rapid urbanization as other major city has been experiencing.

In contrast with other big cities in various parts of China Chongqing has its unique potential in launching particular plan of urbanization.

a) It has the superiority in gaining central government's support, especially financial support, within the western area of China, and it has already experienced the rapid growth in economy since the establishing of the direct-controlled city since 1997. In addition, superiority lies in attracting foreign investment compared with other western cities.

b) With the boost in economy, Chongqing becomes popular in attracting workforce not only from its administrative area but also from other provinces in the western district of China. The growth of population accompanies with the growth in jobs offered there. Also, the cost of living in Chongqing is relatively low in contrast with Shanghai or Beijing, which makes the city a more available choice to people around the city.

c) Meanwhile, the infrastructure of Chongqing has been well constructed for 15 years, with adequate public transportation, especially the light rail transits, and residential condition. The level of resident's living standard is steadily rising through this period and the price of residential buildings is also rising through the time, though in average, prices of houses are still not comparable with that of other three direct-controlled municipalities

d) The Three Gorges Dam is located in the east to Chongqing and such a project is the sufficient energy backup for Chongqing, but the existence of the project also has impact on the ecological system of Chongqing. The natural sources, especial minerals and hydro power, are abundant in Chongqing and could become the advantage for its development.

e) From environmental perspective, Chongqing has been conducting special projects and measures in treatment of industrial pollutants. The quantity of emission of waste air, water and solid substances are shrinking tremendously during the last decade. The reduction in industrial contamination necessarily backs up the urbanization of the city.

f) There still exists sufficient land for further expansion of the city and the potential construction for the next decade could be carried on without much geographical limitation.

Despite of all those potentials mentioned above, dilemmas still exist in the development process of Chongqing.

a) The urbanization of Chongqing has boosted the population of the downtown area of the city. As more people are accumulated in the city, the municipality will be more burdened by the population. The daily emission of sewage is rising and the environment is experiencing the pressure created by the social modernization.

b) The deficit which the city is running is excessively high according to the income of the government. High level of debt of the government may contribute to deep social and economic problems such as inflation and crisis in governmental credits, which are not phenomena for steady growing.

c) The government of Chongqing has concentrated on the control on industrial wastes including waste gas emission, treatment of waste water and waste solid. However, concentration is also needed in the control over the daily public sphere such as the domestic sewage. Furthermore, the use of renewable energy is vital towards sustainable development.

d) Furthermore, similar with phenomenon appeared in other main cities in China, Chongqing is also experiencing over construction in buildings, roads and other forms of infrastructure. Some constructions are not conducted under discreet municipal plans, creating problems of excessive simultaneous projects which disrupt the life pattern of residents. Problems in the waste of resources, both in raw materials and energy, are aroused as well.

e) The city is sprawling through the process of urbanization; therefore the energy consumption should not be only largely depended on the thermal power by burning coal. The proportion of hydro power in the total generating capacity should be raised in order to guarantee the sustainability and environmental-friendliness.

6) Through the utilization of hydropower, however, the ecological condition of the three gorges area arouses major concern from both the academic and public spheres. The establishment of the dam has greatly changed the geological structure of the region, thus the relatively frail ecosystem has experienced damages to some extent. The problem with the ecosystem should not be ignored when people are enjoying greater output in electricity generation.

3.4.4 Chongqing: Development model and trends of sustainable urbanization

Chongqing's sustainable development model should be based on the basis of better utilization of its regional and indigenous advantages.

a) On economic aspect, the current model of growth is similar to those other big cities in China—government investment promoting the demand of the whole social community. As the government is in charge of the most affairs of most of the spheres of the society, it should also play important role in maintaining the balance and upholding the social welfare. The infrastructure construction should be continuing to meet the requirement of the increasing population. The market should be open to foreign investment as well. Controlling the expenditure of the government is also of equivalent importance. The budget should be balanced as planned and expected with deficit at proper level.

b) As investment flows enter the city of Chongqing, more projects will create more jobs in the city and subsequently the upcoming workforce will be greater.

c) The land use of urban area could be expanded with careful plans and projects to fully utilize the resources.

d) The control and treatment on industrial waste gas, waste water and waste solid should be kept carrying on under rigid regulation. It is also essential to set improvement in the control over emission from daily social part.

e) The energy structure can be further optimized by advancing utilization of renewable energy. The ultimate purpose is to maintain the sustainability under the pressure of urbanization and create a municipality meeting the need for the process. Trends in sustainable urbanization also lie in various aspects above. The total economy will keep growing with large quantity of financial support flowing to the city. Urban population will still rise at the same time. The treatment in industrial wastes will remain at the current level. Energy consumption can be considered as sufficient in the foreseeable future. Continuous pressure from the growing number of urban population and urban constructions will be fatal element in hampering the city obtaining appropriate environmental quality.

3.5 Kunming

Kunming is located in southern China. Downtown of the city is in the north of Dian Chi basin, south Dian Chi is surrounded by mountains on three sides. The terrain of Kunming is lower from north to south. Most area is between 1500-2800 meters above sea level. The highest elevation is 4247 meters and the lowest elevation is 746 meters, while the average elevation is 1894 meters.

3.5.1 Kunming: Development potential and dilemmas

As the capital of Yunnan province, Kunming is a gateway city open to Southeast Asia and South Asia. And also, being an important tourist trade city, Kunming has good development prospects. The local government pays a high level of attention to its development and economic investment. But at the same time, there are problems to be solved in Kunming. Primary industry plays an increasingly dominant role in Kunming. At the same time, the city should simultaneously develop tertiary industry in order to promote the district's overall economic development. Along with economic development, Kunming faces environmental challenges. The poor quality of river water around urban and rural areas is especially concerning. According to the results from Kunming's major river water quality monitoring in recent years, pollution of rivers is quite serious and poses health risks, especially through relatively economically developed townships with dense populations. There are

also serious problems with decreasing water volume. In the area of energy management, the government lacks the necessary capabilities for renewable energy management, a unified survey of renewable energy resources and development planning. Local energy resources such as biomass have not been fully exploited. The construction plan for the city also raises concerns. High density development around the city center has resulted in traffic and inner-city crowding. This style of urban development has also created unequal provision of social services favoring those in the center and underserving those in outlying areas.

3.5.1 Kunming: Development model and trends of sustainable urbanization

The development method of Kunming is the product form diversification and community function compound mode. City scope expands unceasingly and population is outward radiation. Urbanization is increasingly perfect. However, the speeding up stage of urbanization process follows the ecological destruction and environmental pollution acceleration phase. Pollution of the environment is an inevitable threat that urbanization face. So the government should build some environmental policy. Policy is like the implement cleaner production projects, strict environmental access systems, the construction project environmental assessments and energy assessments, and environmental protection, soil and water conservation, “Three Simultaneous” system, etc. Sustainable urbanization, therefore, need to an increase in urban population, the expansion of city and at the same time, strengthening the construction of infrastructure of traffic complex hydropower, science-education-culture-health social security following the demand of urbanization also need to be focus. Meanwhile, strengthening the construction of environmental protection laws, optimizing the structure of urban development and adjusting industrial layout should be paid more attention. To accelerate the transformation and upgrading Kunming vigorously promotes forestry secondary and tertiary industrial development, strives to achieve environment-friendly development pattern, and speeds up the development of ecological economic industry.

PART II - POLICY MECHANISMS

1. Indicator systems[7]

1.1 Urban sustainability indicator systems in China • by Qi Xiaoxu

The issue of urban sustainability has aroused extensive attention in China. Especially urban sustainability indicator system has become the key issue of the research. Based on a series of indicators with internal connecting, indicator systems reflect and evaluate the general situation from various dimensions of society, economy, resources and environment in a region. Therefore, developing indicator systems exerts profound influence on ensuring and promoting coordination between society, economy, resources and environment and sustainable urbanization. Current research of sustainable development focuses on two aspect: 1) theories and concepts of sustainable development; 2) ways to achieve sustainable development. The linkage between these two aspects is that how measures the urban sustainability. Since 1990s, Chinese Scholars raised the idea and framework of urban sustainability indicator systems based on various outcomes of this field. This section makes a brief on 17 indicator systems developed by Chinese scholars for urbanization in China, which are applied in mainly four aspects as the governmental appraisal and ranking, development plan, research institute assessment and academic research projects. It is interesting that few indicator systems listed below have sufficiently recognized the environmental aspect of urbanization.

Indicator systems	Publishers	Contents	Purposes
The sustainable development indicator system of National Bureau of Statistics of the People's Republic of China	National Bureau of Statistics of the People's Republic of China and The Administrative Centre for China's Agenda 21	There are 6 sub-systems as the economy, resources, environment, society, population, science and education with 196 descriptive indicators and 100 evaluation indicators.	Research institute assessment
Sustainable development index system (1996)	Zhang Shiqiu (Peking University)	It is divided into 3 types of indicators as state, pressure and reaction indicators.	Academic research
The sustainable development system designed by Zhang Linquan and Li Xinyun (1997)	Research Centre for Sustainable Development of Shandong Province	It is divided into two threshold conditions as economic development condition and social stability condition.	Academic research
The sustainable development indicator system of Shandong Province designed by Mao Hanying (1996)	The Chinese Academic of Sciences and Institute of Geography of National Development and Reform Commission of the People's Republic of China	It is divided into economic growth, social progress, and support of resources and the environment, sustainable development capacity of the four sub-system layer, each part is subdivided indicators theme, specific indicators under the sub-theme layer with 15 thematic layers and 90 indicators.	Academic research
The sustainable development indicators in China	National Development and Reform Commission of the People's Republic	It includes 23 social development indicators, 18 economic development indicators, six resource indicators, 20 environmental indicators and 12 non-	Academic research

[7] Please see also Chapter 5 for a review of EU systems, in: Bina, O., Balula, L., Ricci, A. and Ma, Z. (Eds.) (2013) *State of the Art Report: Sustainability dimension of urban infrastructure and services*, URBACHINA Project Report no. D4.1, Instituto de Ciências Sociais (ICS), Institute of Studies for the Integration of Systems (ISIS), and People's University (RENDA), 28 February 2013, Lisbon.

(1998)	of China	monetary indicators.	
The sustainable development indicators in China (1999)	The Chinese Academic of Sciences	It is divided into 5 layers as the overall layer, system layer state layer, variable layer and feature layer with 45 indicators in total.	Research institute assessment
Urban Development indicator system in China (2001)	China Association of Mayors	It is divided into four levels as overall layer, system layer, state layer, feature layer with 104 basic elements (or indicators), 19 state elements and 5 support systems.	Research institute assessment
National Healthy City	Patriotic Health Campaign Committee Office	It involves urban and semi-urban areas such as health, public health, environmental protection, disease prevention, patriotic WHO management, health education, appearance and environmental sanitation, environmental protection, public places and drinking water health food hygiene, communicable disease control, urban four pests, units and residential health.	Governmental appraisal and ranking
National Model City for Environmental Protection	Ministry of Environmental Protection of the People's Republic of China	There are 26 indicators involving four aspects of the economic and social, environmental quality, environmental construction and environmental management, covering prevention and control in the total amount of emission reduction, water, air, sound and solid waste pollution, assessment of environmental influence, urban infrastructure construction and environmental protection capacity.	Governmental appraisal and ranking
Construction Index of Ecological County, Municipality and Province (2003)	Ministry of Environmental Protection of the People's Republic of China	It includes three aspects as economic development, ecological environment protection and social progress.	Governmental appraisal and ranking
Urban Competitiveness of China (2003)	Chinese Academy of Social Sciences	Analysis of urban competitiveness from two aspects of the performance and interpretation	Research institute assessment
Sustainable Ecological City (2003)	Zhang Kunmin, Wen Zongguo, Du Bin and Song Guojun	It includes five subsystems: resource support system, social support systems, and economic support systems, environmental support systems and institutional support systems and published in Evaluation and Indicators of Ecocity: Theory, Method and Application.	Academic research
Livable City (2005)	Ministry of Housing and Urban-Rural Development of the People's Republic of China	It involves 6 aspects as social civilization, prosperity and beautiful environment, resource carrying cheap living, public safety which is implemented by percentage system.	Governmental appraisal and ranking
Garden City and Eco-garden City (1999/2005)	Ministry of Housing and Urban-Rural Development of the People's Republic of China	It was divided into qualitative indicators and quantitative indicators.	Governmental appraisal and ranking
National Civilized City (1980/2008)	The Spiritual Civilization Steering Committee of the Construction	It is divided into basic indicators and features indicators.	Governmental appraisal and ranking
National Ecological Civilization Construction Pilot (2009)	Ministry of Environmental Protection of the People's Republic of China	It includes 6 aspects as ecological economy, ecological environment, improve people's livelihood, infrastructure, ecological culture, clean and efficient in total of 33 indicators.	Governmental appraisal and ranking
China Green Development Indicator Report (2010)	Beijing Normal University, South-western University of Finance and Economics	It includes 3 types of indicators as green degree of economic growth, resources and environment carrying potential, government policies support in total of 43 indicators and published in China Green	Academic research

	and National Bureau of Statistics of the People's Republic of China	Development Indicator Report every year.	

Table: Urban sustainability indicator systems in China

1.2 Elements for a new approach • by Qi Xiaoxu

Overall, there are some achievements in the research on urban sustainability indicator systems in China. However, because of less research experience and late start, there are still disadvantages among the existing urban sustainability indicator systems, which are worth making further research.

(1) The existing urban sustainability indicator systems are more emphasis on economic development, while the indicators involving resources sustainable utilization and environmental quality evaluation are less or lack which can not reflect the linkage between the various subsystems. The one crucial reason of the above problem is that there is little fundamental environmental monitoring data and indicators, influencing on the feasibility and objectivity of decision-making of evaluation results directly. Therefore, it is needed to be solved that strengthen environmental monitoring system and environmental statistics.

(2) Due to the descriptive indicators are easier to build and access, the evaluation indicators and developing the evaluation methods are often ignored, resulting in some indicator systems are only applied in describe the tendency in a period of time. It cannot make the specific evaluation ultimately because of less feasibility. Also, too large indicator systems would impact on the practical utilization.

(3) The existing indicator systems are little or no considered periodicity and time effectiveness of sustainable development, which be tended to static evaluation. However, measuring and evaluation criteria for sustainable development is dynamic, thus it should be adjusted according to time and space. It is necessary to consider the indicator systems into the dynamic process, which design dynamic indicators to measure and evaluate the level and capacity of sustainable development in the region. That is the most worth improvement in research on design of indicator systems.

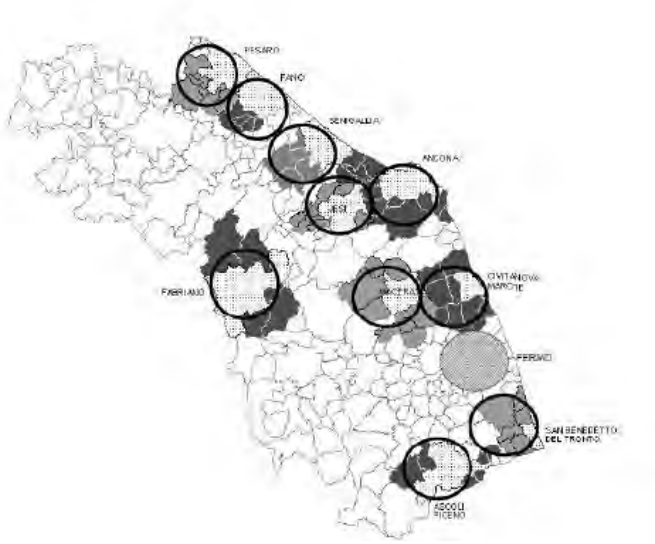
(4) The indicator systems must be combined with the actual situation in the region according to regional differences when choosing indicators to evaluate. For example, there are many differences in natural endowment, economical development, population structure and etc., between eastern provinces and western provinces in China, thus it is important to adjust indicators to highlight regional characteristics.

2. Planning scales and functions: comparing concepts in Europe and China

2.1 Functional Regions: an analytical framework • by Luis Balula and Olivia Bina

"Urban does not stop and rural start on the edge of cities"
(EP-METREX, 2011)

There are many diverse designations of 'Functional Region' in the literature.[8] To some extent they have different meanings, depending on the analytical angle, but all attest to the fact that we cannot reason about cities anymore without including their regional context; all that happens in their hinterlands; their relations with other cities; their relations with regional ecosystems; and their linkages to the rural areas around. In fact, when we talk about cities today, we are talking about ***territorial systems that include urban, rural and natural areas internally linked by functional relationships*** – and we need to look at such territorial dynamics in order to effectively debate urban sustainability. Essentially, sustainable urban development requires the integrated development of entire regions and not just the growth and development of individual cities or discrete urban areas.[9]



[8] For example: City Regions; Polycentric Regions; Functional Urban Regions (FUR); Functional Urban Areas (FUA); Regional Urban Systems (RUS); or Large Urban Zones (LUZ). According to a recently proposed OECD taxonomy

[9] A recently proposed taxonomy for functional regions (OECD, 2010, p. 8-10) includes three major types:
(i) Large metropolitan areas (with one or more large urban cores, where people and firms are highly concentrated)
(ii) Networks of small and medium-sized cities (several urban centers, well connected through functional – often non hierarchical – relations of synergies and complementarities)
(iii) Sparsely populated areas with market towns (functional regions that can be classified as rural)

Fig. 1 – The Marche region, Italy: example of a network of 10 Functional Urban Areas (FUA)

Functional Regions are sub-regional spatial units, non-overlapping with political-administrative boundaries and with relevant levels of (real or potential) internal interdependency. The definition of 'functional regions' may reflect: (i) an urban-rural perspective (e.g. commuting patterns); (ii) a rural-urban perspective (e.g. access to public goods and services in rural areas); or (iii) a transversal perspective (e.g. integrated management of ecosystems that cross urban and rural territories).

The Functional Region concept allows for a joint vision of two strands of questions related to sustainable urban development. First, it includes an important spatial dimension, with a focus on physical planning and a series of nested issues related with the territory, urban form, urban design and the urban environment. And second, it comprises a procedural dimension, with a focus on governance and policymaking (see Fig. 2).

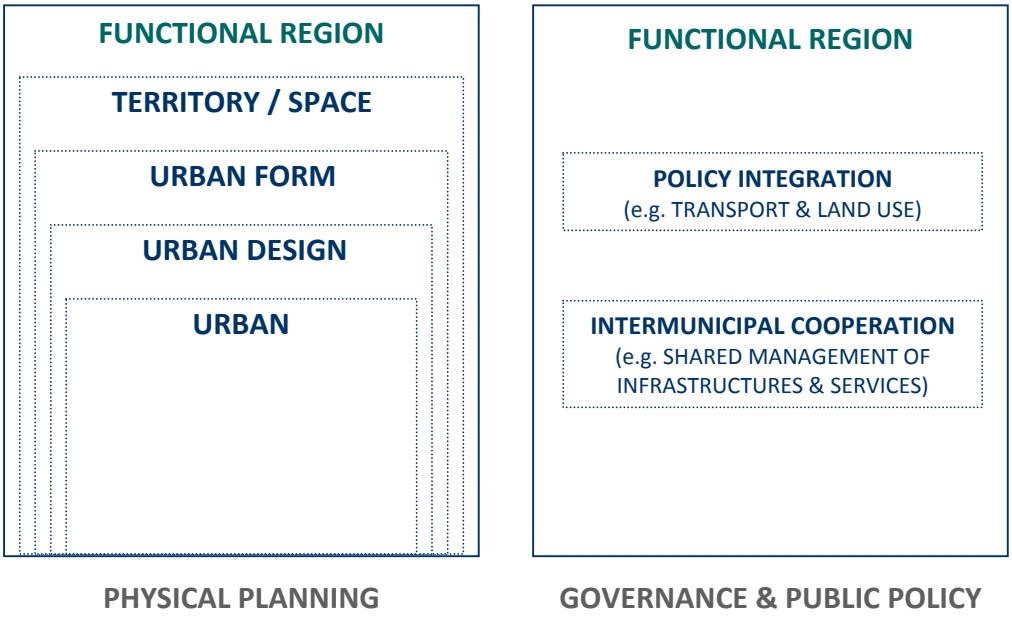


Fig. 2 – The functional region concept: a geo-administrative conceptual framework

From a policy perspective, the Functional Region concept implies three basic ideas: (i) multi-level governance; (ii) intermunicipal cooperation; and, most importantly, (iii) it provides a territorial base for integrating sectoral policies. The territorial dimension is increasingly seen as crucial for policy integration[10]: public policy with a territorial perspective has the potential to improve horizontal integration (between policy sectors) as well as vertical integration (between governance scales).[11]

In sum, a Functional Regional perspective facilitates synergies and policy coherence, and therefore might contribute to urban sustainability. In the scope of URBACHINA, such "geo-administrative"

[10] "A stronger focus on the territorial dimension can improve the coordination and efficiency of public policies and private investments" (ESPON, 2010: 6)

[11] "Better integration of policy can bring added value in times of limited resources. Sector policies conceived in isolation risks to have unintended consequences, which can conflict with the aims of other policies. The territorial dimension is where such conflicts manifest themselves. Just as important is that sector policies can mutually support each other if working for a clear common objective or vision ... Integration also means vertical integration of policy. The skills are to look to scales above and below to consider what cohesion means across scales, and how action at one scale has impacts at another" (ESPON, 2010: 104)

conceptual framework can provide a valuable basis for probing the various substantive issues of sustainable urban development both in Europe and China.

2.1.1 The Functional Region in the Chinese city planning context

While we did not find explicit references to Functional Regions in the literature on China so far, Choe et al (2008) contended that City Cluster Development (CCD) is a key urbanization strategy in China. According to these authors, CCD is a region-wide coordinated approach to the provision of urban infrastructures and services to an urban cluster encompassing towns, cities, villages and rural areas – a definition remarkably close to the notion of Functional Region. It seems, therefore, critical to investigate this conception/trend of the Chinese planning system, so as to contrast and compare it with its European counterpart.

To clarify the meaning of the term, however, an important distinction needs to be made between *Functional Region,* or *Functional Urban Region* and *functional urban area*. While the former represents a complex geo-administrative framework for policymaking, as we just saw, the later is a term belonging to the lexicon of Modernist urbanism that stands for a discrete, single-use urban area, or zone, of a *Zoning Plan*. In a sense, *Functional Region* is the opposite of *zoning* and the notion of *functional urban areas*. *Functional Region* stands for territorial integration (of policies, of scales of decision, of urban 'functions') while *zoning* stands for territorial disaggregation into specialized, usually large, mono-functional urban areas (single-use residential zones, single-use comercial zones, single-use economic zones, etc.). The emergent concept of *Functional Region* attempts to deal with urban complexity, while *zoning*—a 60-years old practice in many developed countries, acknowledged today as a planning liability but still rampant in China—is a crude attempt to spatial simplification which has repeatedly proven to promote spatial segregation, increase automobile dependency and aggravate socio-economic disparities.

2.1.2 Urbanization trends and regional policy: the relevance of the Functional Region concept

Over the last decades, both in Europe and China, new centralities and new peripheries have emerged on metropolitan areas' hinterlands, shaping a new and distinct kind of territory: the peri-urban.[12] The peri-urban is a complex, multi-functional territory crossed by regional fluxes and infrastructures, where diverse types of urban and rural realities coexist side-by-side.[13] Concurrently, a growing number of studies attest to the fact that urbanization as we know it, through discrete urban entities (traditional cities), is giving way to entirely new kinds of discontinuous, leapfrogging, segregated and poorly connected suburban and peri-urban environments across vast territories, ignoring all sorts of institutional boundaries (e.g. Wheeler, 2009; ISOCARP, 2010; OECD, 2010; METREX, 2010; EC-DGRP, 2011; OECD, 2011). Thus, the problematic definition of what constitutes today "the city".

[12] "Current changes in metropolitan areas are not just taking place in 'inner cities', but also in their 'hinterlands'. There is increasing evidence that a new phase of development in terms of the 'urban periphery' is emerging which is no longer only characterised by quantitative growth in terms of population and an extension of the urban fabric. It is also represented by a wider array of economic functions and qualified jobs" (METREX, 2010: 13)

[13] "The peri-urban is not just an in-between fringe; rather it is a new and distinct kind of multi-functional territory. It is often the location for airports, business parks and high-value housing, which are seen as essential to urban/regional development (as per the Lisbon Agenda). It is also the location for problems: urban sprawl; wasted public funds; transport congestion; loss of agricultural land; damage to landscapes and biodiversity; fragmented communities; and lack of spatial planning" (EC-DGRP, 2011: 68)

It is evident that traditional monocentric models of city planning are no longer adequate to understand and manage the complexity of contemporary city-regions. New urban planning strategies are needed in line with polycentric models that account for current urban dynamics and that recognize cities as extensive, multi-centred, spatial/functional entities.[14] To be sure, cities are "embedded in a spatially wider, i.e. 'polycentric' context of the organization of socio-economic activities" (METREX, 2010: 13) – which highlights the critical role of the regional scale for the study, implementation and management of sustainable urbanization policies.

Functional regions are key to regional development policies (Kamal-Chaoui et al, 2009). The delimitation of a functional region might reflect the need for an integrated vision of contiguous territories and the dynamic interrelations between them; for improving the complementarity of businesses, services and infrastructure; for concentrating and coordinating investments; or for developing territorial policies that cross administrative boundaries. The latter aspect is of particular significance, because many sustainability concerns are regional in scope[15] and planning issues inevitably cross municipal borders.[16] However, when spatially confined to jurisdictional boundaries, policies do not take into account the regional economy as a whole; nor can they respond for the overall impacts of their implementation on the regional system.[17] Innovative policy instruments, institutional arrangements and financing mechanisms are therefore needed to deal with the challenges of the polycentric region.

Another related aspect deals with urban-rural linkages. In the context of the functional region debate, the issue of urban-rural linkages is relatively new and, until quite recently, mainly focused on the 'urban' component.[18] Rural-urban linkages are diverse, depending on the characteristics of the functional regions where they take place; they can be determined by commuting flows; population migration; peri-urbanization; partnerships; physical distance; transport infrastructure; ecosystem services; or governance structure (OECD, 2011: 4-6). However, most policies are designed either to 'urban' or 'rural' issues, with little thought given to the complex relationships between the two.[19] Key sectors for regional cooperation, as identified by EP-METREX (2011) are: transportation, climate change, nature protection, energy supply, health, fresh food and organic farming.

[14] "Central city locations are increasingly becoming components of a wider spatial functional entity which comprises headquarters complexes, back offices, airport cities, logistics management, different kinds of housing areas and entertainment facilities. In that sense cities (or even clusters of proximate cities) seem to be integrating more and more with their hinterlands to form multi-centred, functional city-regions or metropolitan areas" (METREX, 2010: 12)

[15] "... such as GHG emissions, resource consumption, growing motor vehicle use, ecosystem health, metropolitan growth management, and disparities of wealth and social equity" (Wheeler, 2009: 864)

[16] "The region is a vitally important scale to sustainability planning. It makes sense to consider many planning challenges at a regional scale since they are regional in nature and cross the boundaries of local jurisdictions" (Wheeler, 2009: 864)

[17] "The administrative geography of local authorities, which has changed more slowly, is increasingly different from the functional geography of the territory. This means that territorial policies take place at administrative levels that do not match the actual spatial extent of the regional economy and that such policies are not implemented with regard to the actual territorial manifestation of their impacts" (OECD, 2011: 7)

[18] "In Europe, for instance, the ESPON programme defined a typology at NUTS3 of urban-rural relationship in 2004. This approach is based on two main dimensions: the degree of urban influence on a given area, and the degree of human intervention. Hence, this approach tends to classify rural areas as "residual" *vis-à-vis* urban or metropolitan regions" (OECD, 2010: note 2, 2)

[19] "The assessment of urban-rural linkages is often limited to the idea of a large urban core that relies on the surrounding rural areas as sources of food, energy, workforce, and recreational goods. Flows are often considered unidirectional" (OECD, 2010: 2)

Recognizing that there are no one-size-fits-all policies, the EU Cohesion Policy also highlights the importance of place-based approaches.[20] The diversity of functional regions calls for policy mixes adequate to local uniqueness,[21] and place-based approaches account for sub-regional diversity and make way to flexible "tailor-made policy mixes".[22]

2.1.3 Governance challenges concerning Functional Regions

The concept of 'functional region'—as opposed to 'administrative region'—has been recommended by OECD as more effective to inform public policy on metropolitan areas (OECD-CDRF, 2010). Functional urban regions, however, are based on variable geographies and require new styles of planning and governance; they can not be managed by policies and plans devised for the traditional city.[23] Planning for sustainability at the regional scale faces two major difficulties: (i) jurisdictional fragmentation, often implying unnecessary and detrimental intra-regional competition; and (ii) sectoral policymaking, short of a holistic vision.[24] Urban planning and governance should be focused on the whole region and on the long run. Concurrently, public policies need to take into account the multi-scalar nature of urban issues,[25] while city governments should seek policy integration through intersectoral strategies.[26]

The creation of city-region partnerships between urban, rural and peri-urban areas to implement a common strategy has the potential to reinforce the linkages between core cities and their hinterlands. Thus, metropolitan, or regional governance is seen as a requirement for effective territorial cohesion: "the effective scale is no longer municipal" (EP-METREX, 2011: 27). Regional governance, however, is still poorly developed and the management of functional regions requires working around dysfunctional administrative divisions and levels of government.[27] Moreover, very

[20] "EU Cohesion Policy as well as the work with the Territorial Agenda put a strong emphasis on local development potentials and place based approaches. The point about local uniqueness is made several times" (ESPON, 2010: 104)

[21] "Place-based policy making can make better use of the unique internal territorial diversity of such regions by applying a tailor-made mix of policies" (ESPON, 2010: 8)

[22] "A place-based approach, integrating sector contributions, can unlock development potentials in all regions and cities, and increase territorial cohesion" (ESPON, 2010: 7); "The territorial diversity of Europe is complex but needs to be understood and translated into tailor-made policy mixes for regions, cities and larger territories" (ESPON, 2010: 103)

[23] "If the planning and management of these regions is based on familiar notions of the classical city, policies and plans are likely to be unhelpful and counterproductive. Analogies with the city are not likely to work: old paradigms may need to be abandoned, traditional concepts rethought, and planning tools reinvented if we are to understand and make the most of these new kinds of rapidly urbanizing regions" (ISOCARP, 2010: 13).

[24] "Fragmentation of the metropolis into often competing jurisdictions and communities undermines attempts at unified planning ... Within fragmented regions, competition for economic development ... frequently set local governments against one another and undercut environmental, land use, or social equity regulation ... Many single-purpose metropolitan agencies ... may work to administer single-issue functional planning, for example to develop transportation systems, but works less well at developing broader regional sustainability agendas" (Wheeler, 2009: 867-68)

[25] "From a policy perspective it is important to understand the territorial scale of urban issues, which may range from neighbourhood or administrative city level to a larger FUA or even beyond. An urban problem may have very local symptoms but require a wider territorial solution ... urban policy needs to be understood and to operate in a multi-scalar context" (EC-DGRP, 201: 12)

[26] "New institutional models are needed ... A dialogue must be fostered between actors in charge of different sectoral policies, such as environment, housing, transport, energy, and those who are in charge of social, cultural and economic development" (EC-DGRP, 2011: 66)

[27] "Administrative boundaries in city regions can seriously impede desirable policy making – for instance when a city's growth occurs beyond its boundaries; ... when competing transport agencies refuse to work to regional objectives; when responsibilities for watersheds and catchments are randomly divided; or when revenues and

often, this 'in-between' level of government faces resistance both from national- and local-level governments.[28] An effort should nevertheless be done to overcome interurban competition and jurisdictional fragmentation, and to adopt polycentric models of regional development that take into account the multiple urban-rural linkages within functional regions.

2.1.4 Funding Functional Regions in Europe

A new proposal for the next Cohesion policy financial framework (2014-2020) is currently under discussion at EU and Member States' levels.[29] The proposal includes ambitious plans to allocate more funds for cities; support the strategic coordination of urban policies across sectors; and encourage innovation by the cities themselves.

Five percent of the European Regional Development Fund (ERDF) will be allocated to a new funding mechanism—the Integrated Territorial Investment (ITI) package—which will fund integrated urban development projects. In line with the proposal, strengthening the role of cities also means to reinforce their integration with the rural areas around, in the scope of functional regions.

2.1.5 Integrating policies and levels of government in line with the Functional Region concept: two European examples

Finally, we want to illustrate the concept of Functional Region as framework for policymaking with a couple of practical examples showing how some European regions are operationalizing the idea. There are several such initiatives, in different stages of implementation and with various levels of success, all around Europe. The following are just two examples of recently deployed initiatives.

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responsibilities are vertically and spatially distorted. All of these impediments to effective urban management are much greater in non-city rapidly urbanizing regions, where there will be layers of local, rural, municipal and regional governments and special-purpose agencies and districts already in place" (ISOCARP, 2010: 16)

[28] "Although metropolitan regionalism appears to be on the upswing, it is still a weak level of government in most places, and it is far easier to analyse city regions than to plan for them ... The metropolitan region is generally seen as an in-between level of government, without strong support from above or below ... Regional agencies often serve at the whim of higher-level government, which tends to be reluctant to part with power and can capriciously dissolve or reorganize them ... Meanwhile, local governments may bitterly resent metropolitan agencies ... Local elected officials have little political incentive to collaborate regionally, and tend to resist any loss of local power" (Wheeler, 2009: 867)

[29] European Regional policy (or Cohesion policy) financing is channeled through three major funding mechanisms: the European Regional Development Fund (ERDF); the European Social Fund (ESF); and the Cohesion Fund

Example 1: Sjællandsprojektet – Structure Project for the Zealand Region, Denmark (2010-2030)

In 2008, 17 municipalities of the Region of Zealand, together with the Ministries of Transport and of the Environment, have voluntarily joined in an integrated project of urban development and infrastructure for sustainable transport at the regional scale, with a view to creating employment, reducing individual transport and CO2 emissions, and increase the region's resilience and self-sufficiency. The main features of this initiative are summarized in the table below.

Sjællandsprojektet – Structure Project for the Zealand Region, Denmark (2010-2030)	
Instrument:	.Strategy
Underlying concept of FR:	.Network of cities interconnected by functional relations, synergies and complementarities
Delimitation criteria:	.Employment hubs and commuting sheds
Objectives:	.To develop urban infrastructure at regional scale .To develop a common housing and transportation policy .To promote attractive cities and more jobs in the region .To adapt to climate change
Domains of intervention (cross-sectoral policies):	.Spatial planning, housing, transportation, economic development, climate change
Leading organization:	.Zealand Regional Council + 17 Municipal Councils
Governance system:	.Intermunicipal partnership
Funding of initiative:	.Non-identified
References:	http://www.naturstyrelsen.dk/Planlaegning/Projekter/Sjaellandsprojektet/

Example 2: AIT, Ambiti di integrazione territoriale – Territorial Integration Areas (e.g. Piedmont Region), Italy (2011 -)

This strategic plan is part of the ongoing redefinition of the Italian framework for territorial development. It is a strategy of collaboration between various development agencies, with a view to manage planning processes of great complexity. Its recent approval represents the first step of a desired institutional change. The Plan has three interlinked components: (i) A frame of reference (the cognitive-structural component of the plan) based on a critical reading of the region—in terms of socio-economy, morphology, landscape, environment and ecology—and of the local and regional networks that structure the Piedmont region; (ii) A strategic component of policy and projects' coordination, which provides the basis for defining the main areas of strategic development as well as the interests and values to protect; (iii) A statutory component (the Plan regulations), defining roles and functions of the various spheres of government of the territory, based on the principles of subsidiarity and local autonomy. The main features of this initiative are summarized in the table below.

AIT, Ambiti di integrazione territoriale – Territorial Integration Areas (e.g. Piedmont Region), Italy (2011-)

Instrument:	.Strategic Regional Territorial Plan
Underlying concept of FR:	.Polycentric region, including 33 municipalities
Delimitation criteria:	.Provincial and municipal administrative boundaries (contiguous and with clear dynamic interactions between them)
Objectives:	.Strategic management of territorial development at the regional scale .Inter-institutional cooperation within the framework of regional planning .Intermunicipal and inter-sectoral cooperation .Coordination of policies and institutional projects of different sectors, different spatial scales and different levels of government
Domains of intervention (cross-sectoral policies):	.Spatial planning, including socio-economic, morphological and environmental (landscape and ecosystems) issues .Governance systems
Leading organization:	.Piedmont Region (www.regione.piemonte.it)
Governance system:	.In principle will be based on a inter-institutional public-private partnership
Funding of initiative:	.Not yet defined, but probably a mix of national and European funds
References:	http://www.regione.piemonte.it/sit/argomenti/pianifica/pianifica/informa/piano.htm. ESPON FOCI research: http://www.espon.eu/main/Menu_Projects/Menu_AppliedResearch/foci.html .

2.2 Applicability of the concept in China • by Craig Hart, Ma Zhong, Yang Zhiyou

Here we review the application of the functional regionalism concept in China. In this section, we begin by discussing barriers to the adoption of functional regionalism in the context of China's current system of administrative and fiscal decentralization. We then consider historical and current examples of limited forms of fiscal decentralization in China focusing on river basin management. Next, we consider the evolving policy of "city clusters" and finally consider whether this policy is likely to support a nascent movement towards regional functionalism or perpetuate the phenomenon in which large megacities dominate smaller cities and rural areas, likely deepening inequality. We believe the outcome of this crucial question will depend on how the "city cluster" policy is implemented and how the dynamics of economic and institutional barriers described in the first section of this part are managed.

2.2.1 Barriers to Functional Regionalism in China

China's form of government features administrative and fiscal decentralization in which the central, provincial, city, and town level governments each possess independent budget, enforcement and staffing authority. China's decentralized administrative structure features strong horizontal lines of authority and comparatively weak vertical authority, has important implications for regulatory and other functions. Thus, for example, a provincial Environmental Protection Bureau is subordinate to People's Congress of that province, which controls its budget and the appointment of personnel. The Ministry of Environmental Protection at the national level can only set targets for each of the provincial environmental protection bureaus to meet. Whether such targets are met would be among the factors considered in the promotion of top personnel from that provincial agency, however these evaluations are carried out by the Party through its cadre evaluation system and implemented by the Party from the center. Moreover, promotion not infrequency results in cadres being elevated from their original agency to a different part of government altogether, further weakening vertical lines of authority. A substantial literature has developed concerning how China's system of administrative and fiscal decentralization drives local government to raise revenue, primarily focusing on leasing land to finance local government operations and attracting industry to raise tax revenue, as well as the socio-economic and inter-governmental inequalities such a system produces (see, e.g., Su & Zhao, 2004; Tao et al., 2007; Zhang, 2006). These economic incentives further weaken enforcement and central authority and foster competition among provinces.

As a result of fiscal and administrative decentralization, the structure of government is antagonistic to the concept of functional regionalism, which implies a heightened degree of cooperation in fiscal matters and coordination in enforcement and other administrative matters across a region.

Notwithstanding the inherent bias away from coordination and sharing of authority, China does have a limited practice that could be deemed to approximate functional regionalism in the management of river basins, and is developing policies that could potentially develop into a more fulsome regional functionalism. It should be no surprise that China's experience in functional regionalism is based on its water resources. Rivers and water resources pose trans boundary pollution and conservation issues for a critical resource, and thus have been one of the earliest examples of this kind of inter-governmental cooperation.

2.2.2 China's First Experiments with Functional Regionalism - Water Management

Throughout China's written history, the management of water resources has played a decisive role in the governance of the country. The first recorded instance of regional management of water resources dates at least to the unification of China in 221 BC when the Zhengguo Canal, a large canal

irrigating the Guanzhong plain on the midstream of the Yellow River basin, was brought under unified regional control to facilitate China's unification under Emperor Qinshihuang, thereby enabling larger crop supply for the Qin's army. In fact, the management of water resources in ancient China was far from being simply a matter of imperial fiat. The philosophy of mobilizing cooperation based on mutual incentives among water users in various administrative regions was already embedded in the cross-border water user association of famers, which emerged in the era of China's agricultural society (Hao and Ji, 2013). After New China was founded in 1949, such cooperation vanished due to the establishment of "people's communes" and "production teams", which were in charge of local irrigation infrastructure construction and water resources allocation. However, since that time, China has revived its longstanding tradition of regional water management.

Today, seven of China's major river basin's are under regional management. Each river basin has its own dedicated governing commission comprised of governments along the river basin, which the Ministry of Water Resources supervises. The World Bank has supported these commissions with the China government. Such associations have reappeared to elevate the efficiency of water utilization.

These commissions typically focus on promotion of environmental protection, ensuring the protection of resources for agricultural development, water conservation for agricultural purposes, and training and economic development among framers dependent on the basin. These commissions may in the future provide a platform for further policy development aimed at protecting watersheds. For example, Zhang and Deng (2005) propose that the establishment of a emission rights cap-and-trade market is promising in ameliorating the pollution issue in the basin as well as stimulating local industries to run in a more environmentally friendly way. Similarly, Song (2009) explores applications of ecological compensation practices between Hebei and Beijing and concludes that further development of legal and other institutions are necessary. Although none of these eco-service compensation arrangements have been realized, the structure provided by a commission provides a readily available and obvious platform of cooperation.

However, the role and influence of these commissions should not be overstated. They fall within the domain of the water management ministry with engagement by the environmental ministry, traditionally weak ministries within the Chinese government. As a result, their purview is primarily limited to conservation and environmental protection. Competing demands such as economic development and closely related exploitation of water resources for electricity production and industry is formally outside their mandate. Indeed, these priorities may trump environmental protection considerations. Importantly, economic development is the primary responsibility of other ministries, chiefly the National Development & Reform Commission. Thus, the NDRC may compete with these commissions for determining the exploitation of these resources. Thus, the concept of "functional regionalism" in which resources are managed holistically and both economic and environmental consideration are before a regional body does not truly apply to these commissions.

Nor should the degree of cooperation among regional governments within these commissions be assumed even with respect to the narrow issue of environmental protection. Additional information about their operation is necessary to fully evaluate their performance in terms of regional functionalism. The potential and limitations of these regional rivers basis commissions - both in terms of their interactions with agencies responsible for economic development and the quality of cooperation among regional governments within the commission - are the subject of a separate study that also examines transportation network examples (described below) being undertaken by the Renmin University team participating in the UrbaChina project.

2.2.3 City Clusters

"Clusters", the conceptual framework of which was initiated by Porter (1990), are groups of companies and institutions co-located in a specific geographic region and linked by interdependencies in providing a related group of products and/or services. Ever since its proposal, governments and academics have also come to see the concept as a means to precipitate urban and regional economic growth. According to Choe and Laquian (2008), "city cluster development" is an urban-led approach that enhances the developmental potential of cities and towns within an urban region by strategically linking their development fields through efficient provision of urban infrastructure and services and innovative financing techniques. The development of city clusters can be perceived as an appropriate example of functional regionalism practices.

China initially embraced the concept by naming ten city clusters: Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta, Central and South of Liaoning, Shangdong Peninsula, West Coast of Taiwan Straits, Central Plains, Middle Reaches of Yangtze River, Guanzhong and Chengdu-Chongqing, the first three of which are considered to be the most maturely developed.

According to *The New National Plan for Urbanization of China (2014-2020)*, the Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta city clusters, cover 2.8% of the country's area, with 18% of the country's population, account for 36% of the entire economic output and are pillars of the Chinese economy. China is set to develop more city clusters. On June 26, 2013, China's National Development and Reform Commission stated that the nation will create 10 additional regional city clusters in *The Report of the State Council on Urbanization Construction Work*. These will include a Harbin-Daqing-Qiqihar-Changchun-Jilin cluster, a Hohhot-Baotou-Erdos-Yulin cluster, a Taiyuan cluster, a Ningxia cluster along the Yellow River, a Yangtze and Huaihe Rivers cluster, a Beibu Gulf cluster, a Central Guizhou cluster, a Central Yunnan cluster, a Lanzhou-Xining cluster and a Urumqi-Changji-Shihezi cluster.

China's eleventh five-year plan (2006~2010) proposed that city clusters should be the main form of further urbanization in China. And China's twelfth five-year plan (2011~2015) further advanced the concept that city clusters of international stature should be gradually cultivated in eastern China and more city clusters should be created in central and western China.

Given the importance of the cluster policy, it is important to understand precisely what is being proposed here and what the likely outcomes of this policy are to be. Fist, the cluster policy is the child of the NDRC. Thus, its primary objective is economic development, which is at the core of the urbanization policy itself. It does seek to urbanize more intelligently, and correct a number of the problems China has encountered in its urbanization path. Among these problems, the sustainability of urban development has widely drawn attention. China's cities consume renewable and non-renewable resources to support productive and household activity. Irrational or excessive use of resources has resulted in waste and environmental damage. Resources will inevitably pose a constraint to sustainable urban development. Moreover, water, land and energy are important material bases of urban development. The availability of resources on a per capita basis is revealing that China faces relative scarcity. Meanwhile, the trend towards low-density urban development coupled with urban population growth presents serious problems. The potential consequences may include inefficient land use, excessive reduction of arable land and other threats to national ecological environment. Therefore, sustainable urban development is the inevitable choice of China's urbanization development.

Thus, the cluster policy is aimed at enhancing the efficiency of resource use. This is clear from its provisions, which although still in general terms, calls for coordination at the regional level of resource exploitation. In March 2014, the CPC Central Committee and the State Council issued *The*

New National Plan for Urbanization of China (2014-2020), which has underscored the need for and outlined a blueprint of the further development of city clusters in China. The plan identifies the eastern coastal city clusters as critical for successful regional economic development, and it emphasizes that eastern city clusters should further evolve and improve and that new city clusters should be supported in the central and western regions. In addition, it also highlights the necessity to enhance the construction of transportation network inside and between city clusters in order to fully support China's regional coordinated development.

The New National Plan for Urbanization of China (2014-2020) is aimed at improving the efficiency of land and resource use, as well as socio-economic and quality of life conditions such as access to education, social insurance and health care; adoption of basic environmental technologies and compliance with standards to protect water and soil, and air; adoption of renewable technologies; and promotion of job training for rural populations. It contains several provision of particular interest calling for closer coordination on such issues as infrastructure development in energy and transport, exploitation or natural resources, cooperation on labor markets and environment. The Plan calls for the breaking down of "administrative barriers and monopolies" (破除行政壁垒和垄断) and the promotion of allocation of resources according to market forces (albeit at the government's direction). With respect to functional regionalism, the vision of the Plan is expressed most fully in Chapter 11 (English is translation):

建立城市群成本共担和利益共享机制，加快城市公共交通"一卡通"服务平台建设，推进跨区域互联互通，促进基础设施和公共服务设施共建共享，促进创新资源高效配置和开放共享，推动区域环境联防联控联治，实现城市群一体化发展。

Establish urban clusters cost sharing and benefit sharing mechanisms, accelerate urban public transport using "single card" service platforms, promote inter-regional interoperability, promote infrastructure and public service facilities sharing, promote innovation and open sharing of efficient allocation of resources, promote regional joint prevention and control associated environmental governance, to achieve integrated development of urban clusters.

The most specific example of cooperation on a regional basis is the transportation system based on a "single card", which would imply a high degree of administrative and economic cooperation or even perhaps a merger of transport systems. Although limited to a single system, this degree of cooperation is significant. This is already planned in at least in one region of China that we are aware of - Chengdu and its neighboring cities- suggesting the concept is being embraced. In contrast, while the concepts of "coordinated development" (协调发展) and "optimization" (优化) are emphasized throughout the document, there are few concrete examples of how do accomplish these objectives. This might suggest that functional regionalism will be confined along narrow sectoral or single-system lines, such as the transportation example. Further research at Renmin University will examine the efforts to integrate transportation systems in the Chengdu cluster and at least one other cluster.

Even more ambitious is the Plan's call for regional cooperation in competing for international capital and opportunities, specifically mentioning Europe and Asia - a call essentially for competition to occur at least through regional clusters if not outright coordination nationally. This would require broader and more intensive cooperation regionally, which would run in the face of barriers described above in section 2.2.1 and established practice.

The Plan also emphasizes environmental priorities are to be taken into account in various places in the document through planning, conservation of water resources, coastal landscapes, international agreements on environment, and protection of cultural sites. The environmental requirements

outlined in the Plan refer to existing laws and regulations, such as environmental impact statements, and in this sense do not necessarily introduce any new environmental policy per se. Yet, the Plan does introduce the concept of environmental carrying capacity of city clusters and at least positions these issues as priorities for a coordination mechanism. In this sense, the Plan may represent an improvement over past practice.

2.2.4 Coordination or Domination?

The emerging conception of city clusters, while ostensibly committed to greater coordination, could strengthen a pattern of larger cities dominating smaller ones, sanctioning this model through Party and central policy. The actual outcome of the city cluster policy will depend on how it is implemented, and specifically how the underlying economic and institutional dynamics between city and country, city and suburb and large city to satellite city are managed. Without intervention to control these dynamics, the policy remains susceptible to serving the interests of large cities at the expense of less economically developed rural and smaller cities.

Thus, if fundamental economic and power dynamics are not checked, the new city cluster policy will not support functional regionalism as the concept is understood but rather serve to undermine the potential to achieve it. He et al. (2005), as described in more detail in Section 6.1.1 of this report, argues that China's present urbanization paradigm is characterized as a resources dependent development paradigm, meaning that the development of close economic ties among cities features inequality, with cities being either dominant or subordinate. Large megacities are dominant and control capital, know-how, labor, goods, information and technology. As a result, these larger cities dominate decision-making by governments, and the interests of the surrounding subordinate cities and rural areas are not fully taken into account. He et al. (2005) notes that a new paradigm, the "mutual symbiotic development paradigm" that aims to connect cities emphasizing mutual benefit, long-term cooperation, joint and equal development, is gaining currency among Chinese policymakers and academics, although its implementation has yet to be realized.

The creation of a coordination mechanism, although highly desirable in itself, poses deeper issues if undertaken in the context of unequal stakeholders. Within a region, a relatively affluent and politically powerful population center could dominate the surrounding jurisdictions. Weaker, rural jurisdictions are often resource rich, and they may enjoy relatively less of the economic benefits of coordination, especially if they lack political or economic leverage to ensure their interests are met in such a relationship. Under such arrangement, rural areas could become low-margin resource exporters with skilled jobs and the best workers moving to the cities. Worse, rural areas may also bear the greater share of environmental impacts, effectively externalizing environmental impacts. This is especially a concern within a political system such as China’s in which local officials are not elected and accountability mechanisms for environmental performance remain experimental and are weakened by economic development considerations and corruption. At its worst the arrangement creates the potential to intensify the age-old subordination of the countryside to the city without protections or benefit for the latter.

Perhaps the strongest indicator of whether China's cluster policy will foster cooperation or perpetuate domination is the way "regions" or "clusters" are defined. The definition of a region is a threshold matter, which can determine the very outcome. If a region is defined politically, based on power relationships, as opposed to organically based on a shared resources such as based on care of a river system. We propose that there are two basic patterns that have emerged in defining regions - expansion and merger. In both patterns, the expansion or merger could be one of equals or unequals - determining whether the ultimate determination of the region or cluster is cooperative or competitive. Further research being conducted at Renmin University is examining this looking at the example of the possible Beijing-Tianjin-Hebei region.

2.2.5 Refocusing Urbanization Policy

China's approach to urbanization focusing on targets has thus far ignored the larger problems associated with urbanization. For example, as rural workers have contributed enormously to urban construction, how to integrate rural migrants with urban society has become a nationwide issue. Also, urban crowding, transportation congestion and air pollution have transformed the nature of Chinese cities and the quality of life. The rapidity of urbanization is perhaps the reason for China's being unprepared to deal with these issues. Nevertheless, greater attention is needed to address these "soft" aspects of urbanization that have a profound impact on the quality of life in China's cities. Greater emphasis on quality of environment and quality of life are essential. As further research at Renmin University examines applications of functional regionalism in China through water and transportation examples, and the city cluster policy in particular, we shall focus on these "soft" issues.

2.3 The 'eco' and 'low-carbon' promise: a critical review of China's Experiences • by Luis Balula and Olivia Bina

2.3.1 Introduction

"We project that China will build almost 40 billion square meters of floor space over the next 20 years... the equivalent of up to 10 New York cities"
(MGI 2009, p.18)

Without a doubt, Chinese urban development in the last three decades has combined scale and speed in unique and unprecedented ways. Overall energy demand in China is expected to more than double between 2015 and 2025, with urban demand reaching 85 to 90% of total demand (Yeha and Wu 1999; Bina et al. 2013). Each year, 10 million people migrate from rural to urban areas, a flow predicted to add up to 350 million new residents in urban areas by 2030, leading to an urban population of 900 million by 2050 (OECD-CDRF 2010). Urbanisation and economic growth have become almost synonymous in contemporary China's public discourse, thus Premier Li Keqiang champions urbanisation as a "huge engine" that will "usher in a huge amount of consumption and investment demand, increasing job opportunities, create wealth for farmers, and bring benefits to the people" (Shen and Loo 2013). Indeed, China's urbanisation process has progressed faster than economic growth since 2004 (Chen et al 2013).

The expansion of urban population and related infrastructure is always resource-intensive, however, China's additional difficulty is that it is expanding at a time when the interrelated challenges of resource scarcity, security and environmental degradation are a major concern in China (Wang 2004). Against this backdrop, the Chinese government subscribed to broad notions of sustainable urban development, and rapidly accumulating social and environmental problems (notably air and water pollution levels) have contributed to push this high on Chinese leaders' agendas (NPC 2011). Urban sustainability encompasses the basic values of environmental quality, economic dynamism and social justice, and requires their application to areas including transportation, land use, urban morphology, urban design, architecture and building construction practices (Wheeler and Beatley 2009). From a spatial perspective, sustainable urban development means that environmental justice, economic growth and social equity are reflected in urban physical buildings and infrastructure. In the Chinese context, this is being translated into the need to combine ecological priorities with the economic imperative of growth: growth should be "healthy" and "scientific" (MGI 2009) and urbanisation should be "smart, green, low carbon, and inclusive" (OECD 2013).

However, there are formidable challenges ahead. Efficient and low-carbon urban growth is increasingly seen as a means to decouple economic growth from carbon emissions, pollution, and resource depletion (Yabar et al 2009). Thus, the concepts of "eco" and "low-carbon" cities (ELCC) have gained fast global recognition as a way to address efficiency shortcomings and reconcile urbanisation and the environment towards a more green economy, and more sustainable cities.

In this inquiry we seek to critically review Chinese policy and practice promoting ELCCs, viewed as the latest search for answers to persistent problems associated with three closely interdependent aspects of urbanisation: development of *space*, treatment of *scale* and pursuit of *efficiency* (hereafter: "space-scale-efficiency nexus"). We examine this nexus through the disciplinary lens of planning and urban design, and sustainable development theories. First, we identify the challenges and limitations of urban policy responses to the *space-scale-efficiency* nexus in China. We then discuss the Chinese agenda for "eco" and "low-carbon" cities (ELCC), aimed at addressing some of the challenges, and we find that key problems in the patterns of urbanisation and planning systems persist. Finally we explore the recent "regional turn", with a specific focus on the idea of functional regions, suggesting this might help Chinese ELCC pilot studies to address these persistent problems.[30] The analysis builds on ongoing work (Bina et al 2013) for the European funded project "Sustainable Urbanisation in China: Historical and Comparative Perspectives, Mega-trends towards 2050" (URBACHINA).[31] It draws upon a wide range of policy, academic and media sources, and uses Google images and photographs of two ELCC pilots: Kunming and Chongqing, by way of illustration of certain spatial characteristics.

2.3.2 Urbanisation as a challenge to sustainability in China

An extensive literature review identifies challenges relating to preferred patterns of urbanisation – such as choices regarding urban form, spatial structure, density, land use and urban design, with implications for the characteristics of natural and built environments at both regional and local level – and also to the more general characteristics of planning systems and governance processes.

Space: "Sprawling" patterns and zoning preferences

In China, centripetal urban growth due to continuous rural-urban migration combines with growing centrifugal pressures resulting from the conversion of farm land into sprawling suburban sectors (Kamal-Chaoui *et al* 2009*)*. Urban sprawl has become a serious issue in China, where megacities are merging with smaller cities and towns and forming vast regions of often disjointed urban, industrial and rural uses. Sprawl is almost invariably the side-effect of policies to promote economic development through urbanisation without a proper definition of *where* it should take place (Couch et al 2007). This is usually coupled with weak planning regulation and/or unsustainable spatial development models, such as exclusive functional zoning.[32] In addition, at the interface between economic growth priorities and local and territorial governance, China's fiscal incentives for land conversion, which make brownfield development and urban renewal less attractive (Lin 2009), can translate into a disincentive for sustainable land use practices, and more generally for the efficient use of scarce resources.

Functional zoning – or the territorial disaggregation of a city's land use into large, specialised, single-use urban areas (e.g., residential zones, economic zones, green zones, comercial zones) assembled together in a master plan – has been applied to many Chinese cities as a way to manage urban growth (Yokoharia 2000). When coupled with sprawl, however, exclusive functional zoning results in

[30] Although, note that the UK has recently dismantled regional planning, in part as a response to austerity planning, which suggests that economic imperatives continue to affect territorial management in rich, as well as emerging, nations.
[31] See: http://www.urbachina.eu/index.php/en/ and http://urbachina.hypotheses.org/
[32] For a critique of zoning see, for example Krier 1984.

over-simplified urban environments distant from one another, increasing spatial segregation and automobile dependency, while aggravating socio-economic disparities by differentiated access to urban services (Leaf and Hou 2006). Thus, a combination of planning and governance is contributing to inefficiencies in the use of *space* in China (Bian et al. 2005) and is exacerbating the negative externalities of sprawl, including social inequality.

Space: Patterns of density

A common response to these mounting problems has been to endorse a "denser" or "more compact" use of *space*, which promotes energy efficiency (Couch et al 2008; Chen et al. 2008). However, Chinese cities are already characterised by high densities, and thus has been found to aggravate problems like air pollution, noise and loss of green space, while having only a relative impact on sustainability. It is even possible for denser urban areas to be less energy efficient if they serve only one purpose (e.g., residential) and urban dwellers depend on other, distant urban areas to satisfy different needs (e.g., work, shopping, leisure) which are only accessible by car or other motorised means of transportation (Kenworthy 2007).

Land use mix and the concentration of diverse activities (the opposite of zoning), are critical to what Jane Jacobs refers to as the "life" of cities (Jacobs 1961), and are now common elements of urban sustainability. Sprawl and exclusive functional zoning, on the contrary, increase the need for motorised transportation, thus also increasing energy consumption and CO2 emissions. Their combination, arguably the result of planning systems heavily biased toward the Modernist model (Duany 2002; Balula 2010), has been creating problems and less than ideal solutions towards sustainable use of urban *space*, first in Europe and the USA – which today are facing and trying to counteract the externalities and diseconomies of this model – and now in China.

Space: Urban form preferences

Besides density and zoning, and the fiscal incentive for land conversion, issues of urban form are also major factors affecting the sustainability of *space*, and thus of urban mobility and transport, energy use and greenhouse gases (GHG) emissions abatement. At regional scale, urban form takes into consideration natural features, urbanisation density and its spatial distribution, transportation corridors, travel patterns and modal choices (Zhang et al. 2012), open space, residential areas, public facilities and activity centres (Calthorpe 2001). At the local scale, urban form deals with street and block layouts and the design of the public realm.

Even though traditional downtowns of Chinese cities are partly comparable to their European counterparts in terms of urban form (see example of downtown Beijing, figure 1), the layout of most new urban development in China has tended to follow the model of the single-use superblock, which poses a serious challenge to sustainability, as we will see. Figure 1 contrasts the urban fabric/form of parts of several world cities with a new urban area in Huangshan, Anhui province, depicted here as example of the ubiquitous superblock pattern of new urban development in China. One such typical superblock, measuring 400x250 metres, is equivalent to five Manhattan's large blocks, or between 10 to 20 urban blocks of central areas of European cities like Paris or Rome. The street connectivity of a Chinese neighbourhood made of superblocks is thus 5 to 20 times lower than that of these cities.[33] This is problematic because street connectivity, together with the presence of diverse activities, is what promotes urban vitality and makes a neighbourhood walkable (Jacobs1961). Just like many European cities, which in the 1960s and 1970s embraced the Modernist canon of free-standing high-rise single-use buildings on a park (see example of Warsaw suburb, figure 1), Chinese cities are being developed according to car-dependent patterns of urban form and land-use allocation.

[33] Street connectivity is mainly a function of block size. It is measured by counting the number of street intersections on a given urban area.

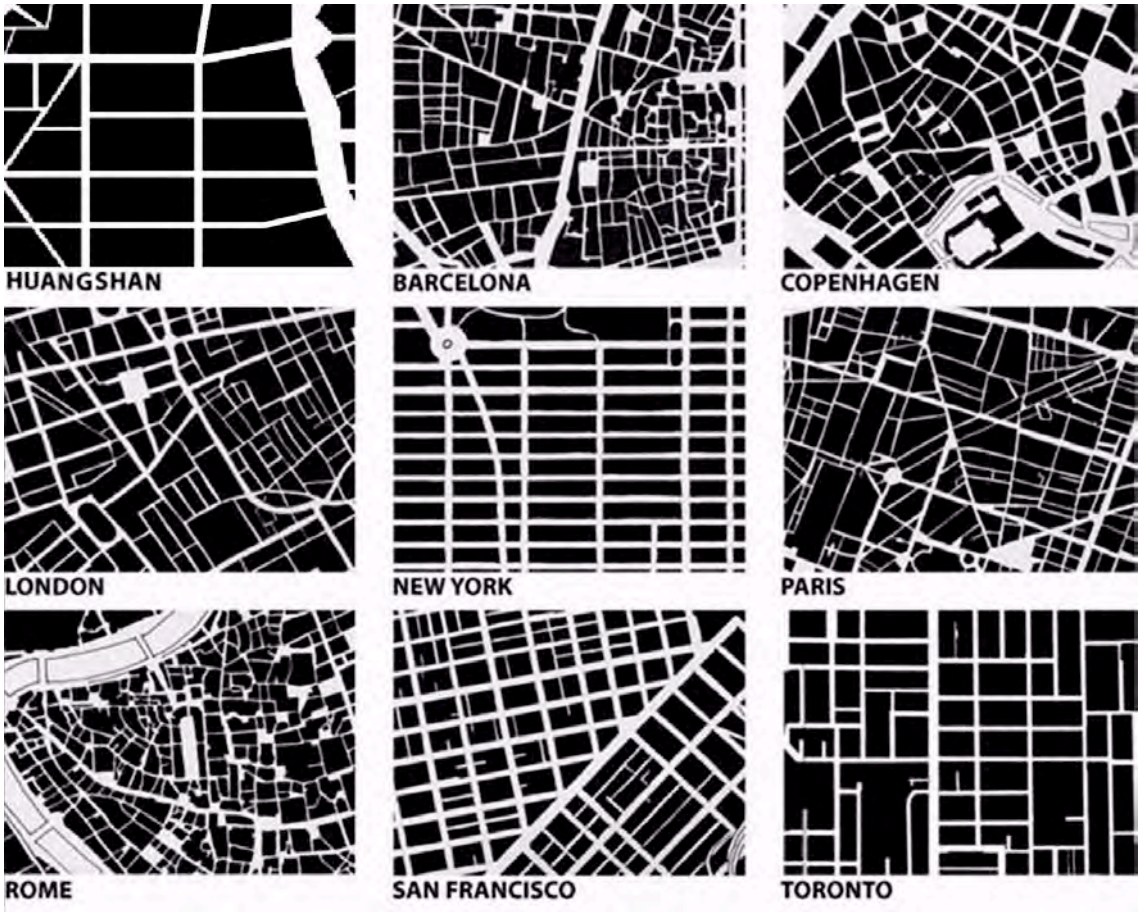

Figure 1 – The Chinese superblock compared to other cities' urban fabric (all maps are at the same scale).
Adapted by the authors from source: bricoleurbanism.org

Figure 2 shows four typical streets of a new residential area in Chenggong, a pilot eco-city in swift development, 20 km south of Kunming. Within each (gated) residential superblock, smaller streets lead to individual buildings. However, the actual public space is made up of very large multi-lane roadways that act like physical and psychological barriers that hinder pedestrian movement. Single-use skyscrapers and high-rises surrounded by freeways promote compact urban form and convey an image of modernity. These are urban landscapes that are symbolically identified with fashionable images of city living and entrepreneurial success (Shen and Wu 2012). Nevertheless, such patterns of development may prove unsustainable in the long run because they generate functionally segregated over-simplified urban environments, which lead to the many problems discussed.

Figure 2 – Typical streets of Chenggong, a pilot eco-city in Kunming, China. *Source: Luis Balula*

European cities are now struggling to counteract the problems generated by fifty years of mismanaged *space*: this should offer a stark lesson to rapid urbanisation in countries like China, yet imperatives of growth appear difficult to overcome (Balula 2010; Couch et al. 2007).

Scale: Planning systems and governance obstacles

Further challenges relate to the overall issue of *scale* in planning and decision making. Most sustainability issues are regional in scale and holistic by nature: this goes against the grain of institutional and sectoral structures of government and governance, and China's drive for growth exacerbates what is a widely shared problem (OECD 2013). Urban development entails decisions from multiple levels of government, sectoral agencies and planning departments, each one with its own scalar and partial approach (Liu et al 2014). Concurrently, city governments tend to follow their own local agenda, often driven by short-term objectives of competitive economic growth to meet the central government GDP targets (Ren 2012; Wu 2012), at the expense of environmental performance and of efficient integration with the plans (and problems) of neighbouring cities and regions. On a positive note, several recent initiatives linked to spatial planning, infrastructure investment and political-economic coordination at the mega-city region level are bringing together different jurisdictions,[34] a trend that leads to what Xu and Yeh consider a "regional renaissance" in the PRC (Xu and Yeh 2011).

Dysfunctional administrative divisions and overlapping jurisdictions lead to disjointed action on issues that transcend administrative jurisdictions, such as watershed management (EEA 2011) or the planning of metropolitan transport networks. These problems emphasise the significance of the territorial dimension of policy integration, and the need for new concepts and governance tools that

[34] Among them, the Northeast Six City Coalition, the Yangtze River Delta, the Beijing-Tianjin-Hebei, and the Chongqing-Chengdu intermunicipal initiatives.

can understand and manage urban space with a clear connection to its wider geographical context (ISOCARP 2010)..

Efficiency: Combined effects and the promises of efficiency

The *space-scale* challenges produce negative effects on efficiency, in two ways: (i) diseconomies and negative externalities, including those related to energy, pollution and health; and (ii) lock-in effects arising from urban form and infrastructure that leads to high-energy and high-carbon paths (ADB 2013; OECD 2013). China's unprecedented investments in infrastructure and real estate are shaping urban environments that will endure for years to come; and urban form is largely irreversible and virtually impossible, or very costly to modify, leading to lock-in (Baeumler *et al*). China's urbanisation trends are driving cities into high-energy high-carbon trajectories, and entire regions into urban form and infrastructure lock-in. Yet, at the same time, responses to the challenges of *space* and *scale* reviewed above are converging towards the ubiquitous goal of "greater *efficiency*". We identify four categories of efficiency-driven propositions: (1) land-use related efficiency, including the well established ideas of "compact cities," of "new urbanism" and the pursuit of "urban-rural strategies;" (2) transport related efficiency, closely linked to category 1, and including proposals for Transit Oriented Development (TOD) strategies and Intelligent Transport Systems (ITS); (3) energy related efficiency, also linked to category 1 and including the proposal for "smart cities," "low-carbon" cities, and local energy generation; and (4) environment related efficiency, which has been driven primarily by ideas of "eco-cities" and/or "low-carbon eco-cities". The *nexus* between space, scale and efficiency, thus characterises both the nature of the problems and their likely solutions.

2.3.3 The promise of eco-low-carbon cities

A broad consensus seems to be emerging around the notions of eco-city and low-carbon city as policy responses to the challenge indentified above, and the Chinese "eco" and "low-carbon" cities (ELCC) agenda, boasts hundreds of eco-city experiments.. There is no standard definition of either concept (Wu 2012) and we found that they are used interchangeably. However, given the weight of ELCC agendas, it is important to clarify some distinctions. Based on key references (ADB 2013; UNEP 2012; Li et al 2012; Wong and Yuen 2011; Yue and Nan 2011), we suggest that eco-cities are spatial and technological materialisations of the principles of low-carbon development and the term "eco-city" should be more properly used for larger new urban developments (which include in their programme, necessarily, low-carbon goals). Conversely, low-carbon should be used for "initiatives," also in existing cities, towards an eco-city agenda. Nevertheless, this distinction is often blurred in the literature. In this paper, we will always refer to the broader eco-city agenda unless otherwise specified.

A recent study of 178 eco-city initiatives worldwide shows a steep increase in eco-cities initiatives particularly since the mid-2000s, when they became a mainstream global trend (Joss et al. 2013), encouraged by international organisations stressing the importance of the eco-city for the green economy (WB 2012), and as "the key to sustainability." (UNEP 2012) This reinforces the link between urbanisation and the economy, promoting eco-industry with a strong focus on efficiency.

In China, the notion of "eco-city" was first advanced in 2003 by the Ministry of Environmental Protection (MEP) and has evolved to include low-carbon considerations. The concept of "low-carbon eco-city," with a focus on energy efficiency, emissions reduction and environmental protection, was formally promoted by the Ministry of Housing and Urban-Rural Development (MoHURD) in 2009, as an approach to the idea of "ecological civilisation," becoming part of the official discourse in 2007 by former president Hu Jintao (Liu *et al.* 2014).

Especially since the approval of the 11th Five Year Plan, the country's leadership has made significant efforts to address the interdependency between environmental quality and economic growth (Bina 2010). Then, under the broad objective of "protecting the environment and improving energy efficiency" the 12th FYP set strict targets for a low-carbon economy: to reduce energy intensity and carbon emissions per unit of GDP by 16% and 17% respectively until 2015, as of 2011 levels (NPC 2012). With respect to "Sound Development of Urbanisation," the Plan advocates, among others, the key goals of "optimising urbanisation layout and form" and "strengthening the comprehensive management of cities." A regional strategy is also broadly delineated around the objectives of "optimising the development structure of land and space" and "coordinating the population distribution, economic structure, land use and urbanisation" (NPC 2012).

Following a first pilot program for national "low-carbon" province and city development, launched by the National Development and Reform Commission in 2010 for five provinces and eight cities (Baeumler et al 2012), the concept has been rapidly incorporated into municipal policy agendas (Ren 2012). Municipal and provincial achievements towards low-carbon targets are evaluated by the "eco-city" and the "eco-garden city" indexes, developed by the MoHURD and the MEP respectively (Zhou 2012). Both systems establish a set of national or regional-specific standards, or targets to become an "eco-city" or an "eco-garden city." Thus, the concepts of low-carbon city and eco-city became effectively interchangeable in the Chinese context.

By 2012, more than 100 Chinese municipal governments had announced plans to build eco-cities or eco-towns (Wu 2012) and one year after that it was estimated that more than 200 eco-city projects have been proposed, were under construction, or had been partly or fully implemented (Shiuh-Shen 2013). Such numbers place China at the forefront of eco-city planning and have turned the country into one vast laboratory for experiments in sustainable city development (Liu 2014). An important characteristic of these "pilot" projects is that they are predominantly large-scale greenfields developments (new cities and new towns built from scratch) in the suburbs of large municipalities; only a few are infill of retrofits on central areas, less prevalent in China given current fiscal incentives to rural land conversion (Wu 2012).

Falling short of addressing the space-scale-efficiency nexus

Many pilot eco-city projects in China are reportedly developing and applying the latest "green" technology for infrastructure, building and transport, and are expected to provide valid lessons for urban development in China and elsewhere (Energy Foundation 2011). However, despite all the rhetoric and publicity, the results of eco-city projects have been quite mixed. Although some have been praised by their efforts in reducing CO2 emissions, many others have been criticised by their high-carbon costs, as they are likely to introduce highways and boulevards which, combined with a rising middle-class aspiring to have a car, will lock entire cities into high-carbon paths (Shiuh-Shen 2013).

"Low-carbon" is often used just as a label, loose enough to fit high-carbon projects (Leaf and Li 2006). In spite of claims of more than 200 cities having set targets to become ELCCs, independent estimates say only about 20 percent of those claims are genuine (Yue and Nan 2011). Even former Housing Vice-Minister Qiu Baoxing recognised that "the eco-city concept has been overused in China, and some projects actually damaged the environment (...) [while] others failed by their blind adoption of foreign models." (In MacLeod 2012).

We argue that the lack of a clear definition for ELCC agendas that includes a focus on the space-scale-efficiency nexus is partly to blame, and explore the guidance provided to local and provincial governments by current "eco-city" and "eco-garden city" indicator systems in order to illustrate the problem. Finding solutions that can improve the quality and performance of pilot eco-city projects is

crucial given central government's intention to scale up and apply to other cities and regions those pilots that prove to be successful models of low-carbon development (Zhou 2012).

Table 1 summarises current indicator systems, which allow for target setting, comparison and evaluation, eco-city planning and management. These need to be better qualified and quantified (Wong and Yue 2011), while the range of sectors and challenges needs to be significantly expanded in order to address the space-scale-efficiency nexus (table 2). Many pilots have failed to address the range of spatial planning and regional governance challenges identified in the previous section for various reasons, including the limited reference to these dimensions in the indexes of table 1.

Table 1 - Chinese eco-city and eco-garden city indicators systems by sector

Sector (Challenge)	Eco-Garden city indicators (MoHURD)	Eco-city indicators (MEP)
Land, landscape and ecosystems	(1) green space coverage in built-up area; (2) public green area per-capita in built-up area; (3) proportion of pervious surface in roads and squares in built-up area; (4) forestation coverage in built-up area; (5) species diversity index; (6) native plant index; (7) citizen satisfaction with environmental quality	(1) urbanization rate; (2) urban public green area per-capita; (3) forestation coverage; (4) proportion of protected area in total land area; (5) citizen satisfaction with environmental quality
Energy	(8) proportion of energy-efficient and green buildings	(6) energy consumption per unit of GDP
Transportation	(9) average speed of major and secondary roads; (10) Proportion of trips by public transport	N/A
Air quality	(11) number of days per year of air pollution meeting or exceeding China's National Ambient Air Quality standards	(7) ambient air quality meeting stipulated standards for different functional zones; (8) intensity of major pollutants emissions (CO2, SO2)
Water use	(12) treated water utilization rate; (13) extent of tap water coverage	(9) consumption of fresh water per unit of industrial value added; (10) industrial water reuse rate
Water quality	(14) quality of water bodies meeting national surface water quality standard; (15) quality of water from pipe network meeting national drinking water quality standard; (16) urban sewage treatment rate	(11) quality of water bodies meeting stipulated standards for different functional zones; (12) quality of centralized drinking water meeting national surface/groundwater standard; (13) urban sewage centralized treatment rate
Solid waste	(17) domestic solid waste non-toxic treatment rate	(14) urban domestic solid waste non-toxic treatment rate; (15) industrial solid waste treatment rate
Sonic environment	(18) noise pollution levels meeting national noise standard in built-up areas	(16) noise pollution levels meeting stipulated standards for different functional zones
Thermal environment	(19) urban heat island effect	N/A
Services and infrastructures	(20) urban infrastructure good condition index; (21) number of hospital beds per 10,000 people.	(17) district heating (or central heating) coverage
Industry and economy	N/A	(18) rural net annual income per-capita (differentiated for developed and underdeveloped areas); (19) share of tertiary industry in GDP; (20) share of GDP invested in environmental protection; (21) passing rate of enterprises that are required for clean production

Adapted from Zhou et al 2012. Original source: Chinese Society of Urban Studies

Table 2 lists 22 indicators with the potential to address the space-scale-efficiency nexus, covering such matters as local and regional spatial structure, regional mobility, housing and transport infrastructure, regional service delivery, and the structure of regional governance. This listing is based on key indicators advanced by OECD for functional regions (OECD 2011) and others with territorial/spatial expression included in the guidelines of the Low-Carbon Eco-City Strategy of the

Chinese Society for Urban Studies under MoHURD (Baeumler et al 2012). The list is by no means exhaustive, and the diversity of Chinese regions does not recommend the adoption of a rigid set of indicators, as these must be tailored to each region's specificities. However, it provides an initial set of ideas on how to better integrate general ELCC-type indicators with the much-needed focus on the space-scale-efficiency nexus, and on the regional dimensions of urbanisation, in line with the stated aspiration, and urgent need to achieve low-carbon development.

Table 2 - Key indicators for addressing the space-scale-efficiency nexus on a Functional Region context

Urban Form and Functional Region Challenges	**Indicators**
Local spatial structure	(1) building density in FAR (floor-area ratios) (2) neighbourhood land-use mix (3) accessibility to urban services and amenities* (4) proximity of transit stations* (5) strength of activity centres (6) jobs/housing ratio (7) block size* and street connectivity (8) network of pedestrian paths and bicycle lanes*
Regional spatial structure	(9) degree of polycentricity** (10) degree of spatial concentration of activities**
Regional mobility, housing and transport infrastructure	(11) share of people who work in a different municipality from that in which they live** (12) average commuting time and distance* (13) share of population living within a certain distance from a public transport station** (14) share of mass transit users* (15) share of green transport trips (16) share of population living at more than 45 minutes from work (17) share of population living at more than 45 minutes from a large city
Regional service delivery (education, health)	(18) share of people living within a distance of 2 km from the closest primary or secondary school** (19) share of people living within a maximum distance of 5 km from the closest health service**
Structure of regional governance	(20) number of local authorities per 1,000 inhabitants** (21) presence/absence of strategic planning experiences carried out at a supra-local level** (22) presence/absence of smart growth developments integrating transport, land use and housing policies

*Indicators included in the 2009 city planning guidelines of the Low-Carbon Eco-City Strategy by the Chinese Society for Urban Studies (CSUS) under MoHURD (see Baeumler et al 2012: 41); **Indicators advanced by OECD for functional regions (OECD 2011)

The flagship Tianjin Eco-city, a Chinese–Singaporean project for a new-city located 45 km from Tianjin, a city near Beijing, claims to have the required conditions for what is effectively low-carbon development, including: TOD principles (see box 1), high density and public transport, mixed land uses, in-situ jobs and mixed-income housing, parks and plenty of public services such as schools and hospitals, as well as renewable energies and energy saving buildings (Yang and Deng 2013). However, configuring the city layout using the typical grid of 400x250 meters superblock might fail to generate the envisioned walkable urban environment (Baeumler et al 2012). As many of the plan's approaches are yet to be implemented, it remains to be seen if all the other positive features will be enough to balance this specific problem of urban form.

The case of Dongtan on the island of Chongming near Shanghai (announced in 2005), was the first grand scale experiment in eco-cities and exemplifies many of the shortcomings of large-scale greenfield developments: "differences in viewpoints in terms of the analysis, emphasis and strategy of the eco-city" among a multiplicity of stakeholders, promoters, state agencies and the city of Shanghai, have caused the plan to stall (Hald 2009). The policymaking process, better interdepartmental collaboration and a consensus around a common vision for achieving ELCC goals are thus essential.

The pilot eco-city projects for Kunming (Chenggong) and Chongqing (Yuelai) offer yet another valuable perspective. The new city of Chenggong, 20 km south of downtown Kunming, was planned for a population of 1.5 million and construction started in 2003. In 2010, the Energy Foundation and the China Sustainable Cities Program commissioned a revision of the city's master plan to incorporate TOD and sustainable urban design principles. The new plan broke down the superblocks into smaller blocks and narrower human-scale streets, with a hierarchy of densities and mixed-uses related to the ease of access to the public transportation system. The same approach is being tested, in Yuelai, a 2.5 km2 new district in the hills north of Chongqing. Large single-use areas, pedestrian-unfriendly superblocks, and a lack of co-ordination with public transport stations in the allocation of land uses were revised following TOD principles favouring "walkable, mixed-use transit centers in and among the rolling topography" (Energy Foundation 2011: 14). Figure 3 is a graphic representation of the street grids of the original and revised master plans for Yuelai and Chenggong. Both pilots are reportedly being scaled up, and regional TOD master plans for the larger territory around the cities are being designed to promote urban form that contributes to lower levels of emissions, energy savings in transport and a more human scale of the urban environment, reflecting the space-scale-efficiency nexus.

Figure 3 –Chenggong, Kunming (above) and Yuelai, Chongqing (below):
Street grids of previous (left) and revised (right) Master Plans.
Source: Energy Foundation 2011

We have selected an example of a conventional urban development in Huangshan, Anhui Province in eastern China, to illustrate how TOD might work at the prefectural city scale. Figure 4 shows a Google image of the same urban area represented in the top left of figure 1. Here we superimposed elements of the TOD model to illustrate what could be done to repair the urban fabric by: (i) identifying the best places for walkable districts; (ii) breaking down the superblocks and wide thoroughfares into a dense grid of smaller streets; (iii) coordinating public transport stations with mixed-use zoning at adequate, variable densities (Energy Foundation 2011).

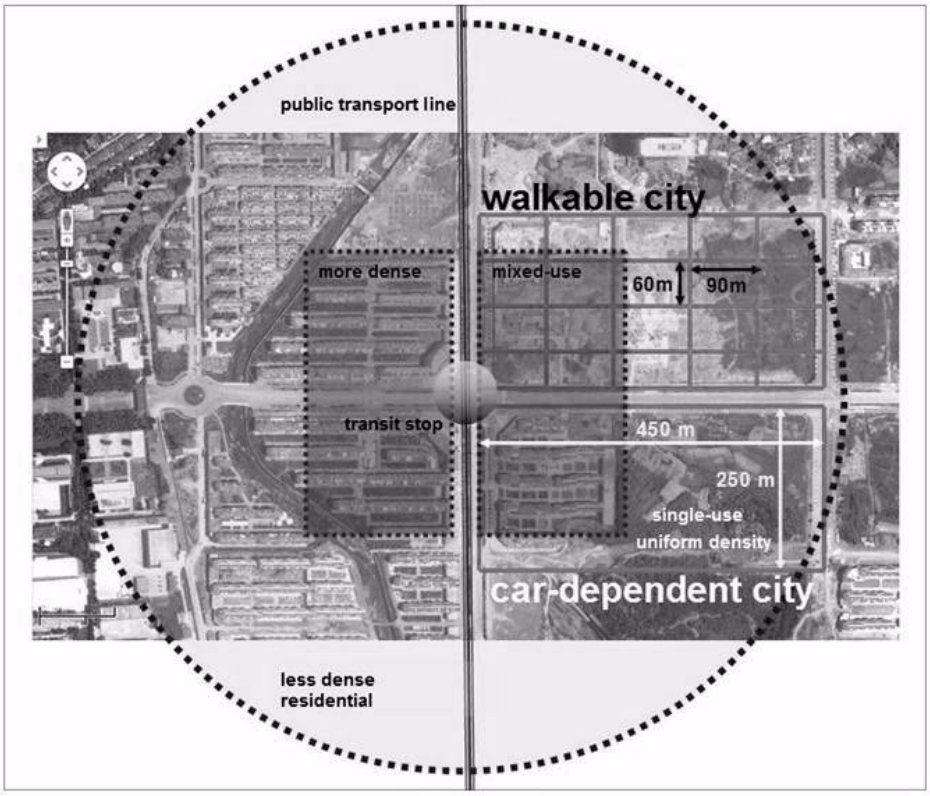

Figure 4 – Restructuring the superblock in Huangshan, following TOD principles
Source: Authors. Photo source: Google Earth

Chinese eco-city trials are very recent and it is too early to assess their impact. However, given the extraordinary scale of the ongoing eco-city experiment and the shortcomings identified in previous eco-city trials, it is urgent to formulate a comprehensive policy and technical measures capable of addressing the space-scale-efficiency nexus.

2.3.4 Functional regions: a policy approximation to the space-scale-efficiency nexus

The affirmation of 'space' in regional policy

In their analysis of worldwide eco-city projects Rapoport and Vernay draw a distinction between those aiming to achieve sustainability through technology and design or through governance and management (Rapoport and Vernay 2011), echoing the challenges we identified both in our overview of general urbanisation patterns and of ELCC approaches. Their study reveals a clear preference for technology and design-led approaches, but Rapoport and Vernay conclude that in order to achieve sustainable, low-carbon cities, urban policies should also focus on spatial planning and territorial governance processes, consistent with our emphasis on the space-scale-efficiency nexus. The question remains, however, of how to bring these spheres together in policy-making. We find some answers in trends towards regionalism and "place-based" policy making in in China (Barca 2009).

Most conceptualisations of metropolitan or regional systems emphasise the relevance of the space-scale-efficiency nexus for city-making, so that all that takes place in a city's hinterland is part of the same "urban" system (METREX 2010). This implies major shifts: a shift from sectoral to territorial approaches to development; a scalar shift from both the national level and the local scale of the municipality to the sub-national level of the region; and a shift towards governance structures capable of ensuring both vertical integration (between levels of government and scales of

intervention) and horizontal integration (between policy sectors) (Rodriguez-Pose 2008). Crucially, the aim is that policy-making at the regional level adjusts to the diverse contexts, and the "city-region" becomes a critical geographical unit for place-based approaches and place-specific policies (ESPON 2010).

The space-scale-efficiency nexus becomes instrumental to competitiveness and growth.[35] It is in this context that the concept of "functional region" gained particular pre-eminence (Barca 2009). Functional regions may be defined as large spatial sub-regional units, non-overlapping with political-administrative boundaries, which include interdependent urban, rural and natural areas internally linked by functional relationships. The demarcation of a functional region may reflect: (i) an urban-rural perspective (e.g., commuting patterns, employment markets); (ii) a rural-urban perspective (e.g., access to public goods and services in rural areas); or (iii) a crossover perspective (e.g., integrated management of ecosystems that cross urban and rural territories) (Ferrão et al 2012). Some of these considerations can be captured by the indicators used by ELCCs (table 1), however, they can be measured by indicators suggested in table 2.

Rising notions of 'functional regions' in China

We find that China is making progress in a direction of spatially and regionally oriented urbanisation that echoes several of the characteristics mentioned above. In Wen Jiabao's words, the country needs to "promote the sound development of urbanisation by making plans scientifically, balancing geographical distribution, coordinating urban and rural development, using land economically and tailoring measures to local conditions" (Xinhua 2012). Moreover, the national policy framework put forward in the 12th FYP embraces the notion of City Cluster Development, or a region-wide coordinated approach to the provision of urban infrastructure and services to a wide territory encompassing towns, cities, villages and rural areas – a definition remarkably close to that of European functional regions (ADB 2008). Indeed, a recent wave of policies and practices confirms the re-emergence of regional governance in China, with a significant level of regional coordination already taking place at city, prefecture and regional level. After decades of fragmentation driven by the downscaling of governance that began in 1978, leading to intense inter-city competition, the central government has been actively promoting over the last decade regional policies and plans to address regional inequalities and boost regional coordination (Yi and Wu 2012). While the "mega-city region" is increasingly recognised as the appropriate level to manage local and regional economic policies, strongly linked to spatial planning and urban infrastructure investment (Xu and Yeh 2011), local governments are seeking greater cooperation through inter-city associations, regional planning or regional policies with the aim of resolving region-specific crises or problems (Li and Wu 2012). Well-established examples, include, the Pearl River Delta Economic Zone, and the coordinated mechanism to cooperate in air pollution control for Beijing, Tianjin and Hebei (Jinran and Xin 2013).

The new national urbanisation plan announced in March 2013 at the opening of the 12th NPC (Jingli 2013), should offer a more elaborate spatial perspective, capable of addressing the issues of urban form identified above. According to Yang (OECD 2013), the plan is supposed to include the following key goals: i) promoting the large spatial form of city clusters; ii) adopting instruments that affect urban spatial form (e.g., urban boundary, urban planning standards); and iii) putting in place a better urban management governance mechanism. This last point is of particular relevance since in China local governments and provincial agencies have great discretionary decision making powers over urban development but this is often accomplished at the expense of cooperation across sectoral and jurisdictional boundaries (Baeumler et al 2012). Jurisdictional fragmentation often implies functional

[35] See: http://ec.europa.eu/regional_policy/what/index_en.cfm

diseconomies and detrimental intra-regional competition, which is perhaps the greatest expression of the tension between growth and the environment: GDP growth remains the primary driver of urbanisation, and of individual officials' careers, leading to hurried land conversions and rising competition to attract business amongst municipalities (Lin 2009). Major challenges to regional policy and spatial integration also arise from the complexity of spatial structures, characterised by fragmented and complex coalition partnerships between the state and capital (Gu ad Wu 2013); and from the structure of fiscal revenues of local governments (Lin 2009), which are generated through land transactions and property development and are the core driver behind urban sprawl.

Spatial-geographical and administrative conceptions of the region

Chinese urbanisation theory and practice has been informed by North America's experience, where important propositions relating to the space-scale-efficiency nexus have been developed for over two decades. Affirming itself as a major paradigm shift in urban planning, the theory and practice of New Urbanism highlights many of the elements present in eco-city notions, such as transit, walkability, environmental sustainability and social integration (Wong and Yuen 2011), while emphasising the idea of a formal and functional continuum from the larger region to the building site that needs to be properly understood in order to achieve sustainable patterns of urban development. A summary of three interlinked conceptions of the city-region, which have ultimately coalesced under the scope of New Urbanism, are presented in box 1.

Box 1 – New Urbanism Conceptions of the City-Region

Transit Oriented Development (TOD) [(a)]

- TOD is associated to the idea of polycentric city. Its goal is to promote denser, functionally mixed, pedestrian-friendly urban "nodes/places" around mass-transit stops – usually a light-rail connecting all the "nodes" – which function as major activity centers for a surrounding, less dense residential area.
- TOD strategies aim at both improving intra-regional low-carbon mobility and local accessibility. In terms of spatial planning, TOD provides a sustainable alternative to conventional sprawl as well as to land use policies based on functional zoning and uniform densities. It is matched with the idea of "regional building blocks."

Regional Building Blocks [(b)]

- Closely associated to TOD (above) is the notion of regional "building blocks," an integrated vision of the city-region and the relations between the built and natural environments.
- At the regional scale, building blocks are defined as: "centers" (denser, mixed-use urban areas that include jobs, housing, services and retail); "districts" (special-use areas dominated by a single, primary activity); "preserves" (open-space, natural and rural areas that frame the region); and "corridors" (connectors of the region's centers and districts, which can be either natural systems or infrastructure and transportation lines).
- At the local scale the "neighborhood' is considered to be the basic structure of centers and districts.
- This conception implies that there are parallel design strategies both at the regional and neighborhood scales, which should be jointly developed and implemented.

The Transect [(c)]

- A concept and a planning tool, promoting the regulation of urban form and uses through a coding system that avoids the problems of sprawl and zoning, the transect strategy seeks to organize the physical elements and typologies of the human and natural habitats – such as building densities, land uses, open spaces, green areas, buildings and streets configurations – along a territorial continuum with gradually different levels of urban intensity, ranging from "rural preserve" to "high-density urban."
- The transect situates urban form/design within an environmental framework and proposes a comprehensive methodology for planning at the regional scale and designing at the urban scale.

[(a)] Calthorpe, Peter (1993), *The Next American Metropolis*, New York: Princeton Architectural Press.
[(b)] Calthorpe, Peter and William Fulton (2001), *The Regional City: Planning for the End of Sprawl*, Washington, DC, Island Press.
[(c)] Duany, A. and E. Talen (2002), 'Transect Planning' *APA Journal*, **68** (3), 245-266.

The city-region provides additional answers to China's challenges described above. TOD-based regional strategies (see box 1) are being adopted by an increasing number of cities throughout the world and promoted, amongst others, by the World Bank in China. ELCC cases have focused on TOD, while cities like Beijing, Shanghai, Shenzhen and Guangzhou have been gradually accepting it as an important concept for urban transport planning (Jiang and Zhenyu 2010). It must be noted, however, that given significant structural differences of speed and scale of urbanisation, New Urbanism ideas have been approached quite differently in China and in Europe. While in Europe their influence on planning systems has been incremental, in China they are strongly associated with a recent core policy shift (at least rhetorically) towards low-carbon development. Local governments and Chinese investment corporations typically hire foreign development corporations, such as Atkins or Calthorpe Associates (which advocate New Urbanism principles of sustainability) to devise the master plans for the new cities. In turn, the central government, faced with international pressure to cut down GHG emissions, is keen to support ELCC experiments that announce themselves as sustainable and eco-efficient (Wu 2012), even if they are large-scale developments in remote areas, where rural land is easily available, compromising many core aspects of sustainable development.

In order to address the space-scale-efficiency nexus, ELCC development needs to be grounded in strategic visions for entire polycentric regions. It is in this context that regional strategic planning is gaining traction in China, as a mechanism of economic development based on territorial development that acknowledges place-specific socio-economic assets (Xu and Yeh 2011). Eco-city initiatives need to operate in a multi-scalar, multi-policy context so as to achieve the goals of "optimising urbanisation layout and form" and "strengthening the comprehensive management of cities" as stated in the 12th FYP and in reviews of practice (Baeumler et al 2012b). The two illustrations from Kunming and Chongqing show some progress towards these objectives, by addressing, at least in part, the challenges of the spatial-scale-efficiency nexus, but far more needs to be done to avoid unwanted lock-in patterns, and if the objective of replicating and scaling up ELCC pilots is to make a real contribution to sustainable urbanisation in China.

Our review of policy and practice suggests that, given the complexity of sectoral and administrative arrangements required for large-scale ELCC pilot projects, these would benefit from being embedded in what might be called a *geo-administrative strategic framework*, drawing on the Functional Regions concepts revised above. In figure 5 we propose the key dimensions of an approach based on the functional region concept, including: (1) a *spatial (geo) dimension* focusing on physical planning and issues of urban form, land use, urban design and the quality of natural and built environments; and (2) a *procedural (administrative) dimension*, focusing on governance and concerned with policy integration, intermunicipal cooperation and multi-level governance.

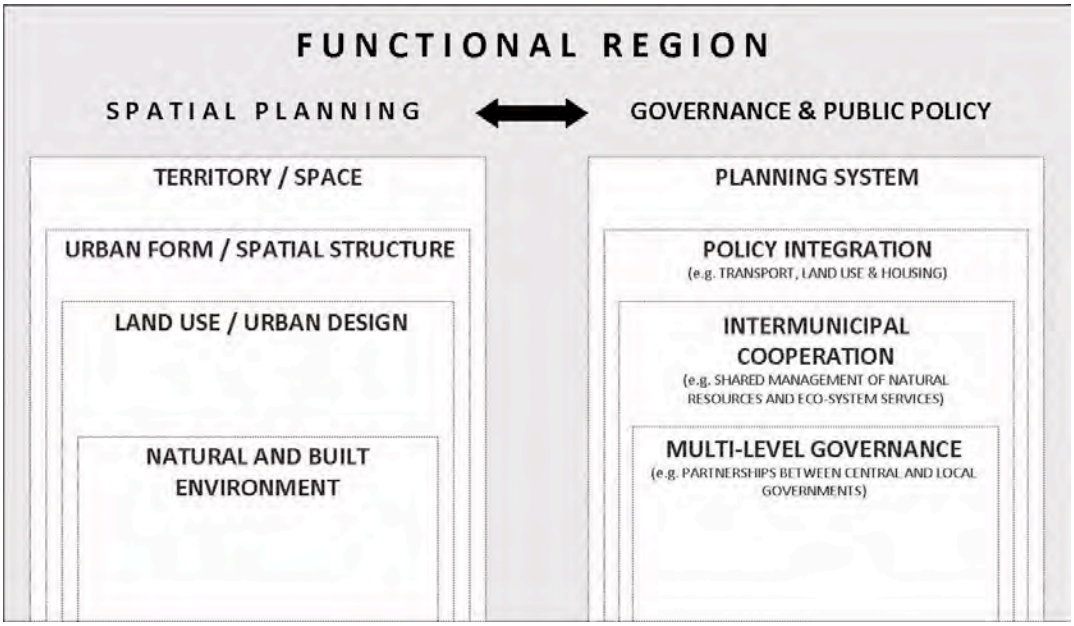

Figure 5 – Functional region as geo-administrative conceptual framework. *Source: authors*

To work, an ELCC *Geo-Administrative Strategic Framework* would have to be defined at the highest level of government (e.g. National Development Reform Commission), acting as a forward-looking programme that provides the regulatory and financial means to push the boundaries of current ELCC pilots, finding innovative solutions that integrate all dimensions in figure 5. The Framework would promote a flexible agenda, allowing for place-specific policy responses and adaptable to local experimentation, inherent to ELCC projects, while promoting comprehensive solutions for the natural and built environment, from the larger region to the building site (see figure 5 and box 1). In order to counter political and spatial fragmentation in China, the Framework could actively promote channels and means of intermunicipal cooperation, within pilot multi-level governance arrangements involving intermunicipal partnership with the involvement of central state departments (e.g., Ministry of Transports, Ministry of Environment), among other stakeholders, to deliver spatially coherent, and resource efficient city-regions. Something being tested also in Europe.

Finally, in terms of monitoring performance and identifying best practice for scaling up, we recommend changes to the existing systems so as to better address the space-scale-efficiency nexus. Table 2 proposes several key indicators to address both the *spatial* and the *procedural* dimensions of urbanisation. Among them, the number and type of strategic planning experiences carried out at supra-local level, for example, could be used as proxy to measure the effectiveness of regional cooperation.

2.3.5 Conclusion

In China, the 21st century will be shaped by the process of urbanisation, driven by economic priorities and inextricably linked to resources and ecological constraints. For this to be sustainable, we have argued that current practices must do much more to address the *space-scale-efficiency* nexus. Our critical review of their theory and practice shows how government and practitioners struggle to embed policy-making in holistic visions of the territory, but equally, we find clear signs of shifting agendas, partly triggered by economic and ecological necessity. The Chinese pilots for ELCCs attest to the political will to change the course of urbanisation towards more sustainable paths. However, the combination of speed, scale, the imperative of GDP growth, and the related fiscal-land-property bind for generating local government revenue to promote economic development – too often neutralises the impact of the ELCC agenda in China. As a result, the risk of lock-in for most

decisions implying a spatial and physical change is raised to exponential levels, meaning that the window of opportunity to shift towards a more ecologically and socially sustainable direction is closing fast.

Given the strategic importance of ELCC pilots, the risks of lock-in, and the prospect that they might serve as example for hundreds of cities throughout the country (and the World), a significant improvement in ELCC practice is somewhat urgent. Thus, based on the premise whereby an effective policy response must be, at the very least, commensurate with the challenge(s) it claims to focus on, we have proposed that ELCC pilot *projects* be embedded in a *geo-administrative strategic framework* that gives municipalities within city-regions the means to identify and implement innovative solutions to the address the space-scale-efficiency nexus, and the underlying political and economic drivers of current rapid urbanisation and its intrinsic conflict with ecological priorities. The recent policy and political developments in China suggest that the time is ripe for engaging in new approaches to sustainable urban development.

3. Paradigm shifts

3.1 Paradigm shifts and the sustainability debate at global scale and for the urban theme • by Luis Balula, Olivia Bina

3.1.1 Do (certain) paradigms shift?

Paradigms are widely accepted theories, as well as worldviews. They shape our perception, interpretation and reasoning; they are ingrained in one's culture and provide a context for though and action; they establish norms; they are often referred to as "the unwritten rules of society".[36]

As defined by Kuhn with reference to the hard sciences in his well known essay *The Structure of Scientific Revolutions*, a paradigm is a body of intertwined theoretical and methodological principles that sets the rules and standards for research practice within a particular scientific tradition. A shared commitment to a paradigm ensures that scientists and researchers are committed to the same rules and standards for research practice and theory building. Paradigms, thus, help scientific communities to frame their discipline, define areas of relevance, formulate questions, select analytical methods, and create meaning (Kuhn 1962).

A paradigm shift—or a fundamental change in shared assumptions— takes place, according to Kuhn, when an *anomaly*, or a *crisis* (such as persistent failure to solve a major problem) undermines the basic tenets of current scientific practice (what he called *normal science*). Such shifts are described as *scientific revolutions*—"the tradition-shattering complements to the tradition-bound activity of normal science" (Kuhn 1962: 6). A paradigm shift—the process upon which a dominant theory or worldview (i.e. how you interpret reality, what you believe to be true) undergoes a radical change—is thus equated with a "revolution" in a system of thought, requiring fundamental changes in deeply established beliefs and a profound re-evaluation of prior assumptions.[37]

In opposition to this theory, Lindblom (1959) developed the notion of gradualist, incrementalist change, which will be relevant as we go on to analyze to what extent urbanization trends in China and Europe reveal a shift from the current paradigm, or an incremental change, more in line with Lindblom's theory.

Over the last decades the concept of paradigm shift became of popular use in many other contexts, essentially to express a sudden change in the way a problem is perceived, or a change in point of view, or a deviation from the norm, or even the adoption of alternative lifestyles and personal beliefs. As a matter of fact, it has been used in countless (scientific and non-scientific) discourses, to the point of becoming a meaningless slogan.[38] In part, this has also been the case with certain

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[36] Original author unknown, abundantly cited on the internet, for example in: http://ag.arizona.edu/futures/era/eramain.html (accessed 09/08/12)

[37] An important and relevant critique of Khun's theory is developed by Minnich (2004). In particular, she discussed how errors entrenched in thought and communication can replace reality and how pathologies of rational systems of thought, including systemic exclusions, are built into the foundations of dominant paradigms. This makes change more difficult and less rational or linear. Minnich therefore contends that there is a deterministic catch in Khun's reasoning: a progressivist conception of change.

[38] See, for example, A New Paradigm in Banking, in http://www.huffingtonpost.com/jon-stein/is-honesty-a-new-paradigm_b_1687902.html (accessed 26/09.12); Paradigm shifts in the video game industry, in http://www.emeraldinsight.com/journals.htm?articleid=1852561&show=pdf (accessed 26/09.12); A New Paradigm in Pediatric Medical Education, in http://www.ncbi.nlm.nih.gov/pubmed/11015540 (accessed 26/09.12); and so on.

interpretations of "sustainable development"—another overused catchphrase, which lay dubious claims to the idea that they represent a paradigm shift.

Sustainable development—*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*[39]—has been framed and re-framed lately by numerous institutional responses to the recent financial and climate change crises (e.g. EC 2010, NEEA 2009, OECD 2009, UNEP 2009, UNESCAP 2009) which, one way or another claim the need for an urgent change of approach to economic growth. The prevailing answer however, "under the various labels of green economy, green growth, sustainable growth [and] green new deal" does not constitute a paradigm shift because it remains clearly within the boundaries of mainstream economics. This is especially relevant to urban sustainability, given that part of the debates on green economies include the theme of low-carbon cities, often considered a paradigm shift in its own right (e.g. ISOCARP 2009; Bulkeley et al 2011; C40 Cities 2012). Even if acknowledging the existence of ecological and societal limits, the dominant response reifies the postulate of continuous economic growth, only this time it is "green" growth (Bina and La Camera 2011: 2310). As it is, despite claims to the contrary (see, for example, Edwards, 2005), "the ongoing crisis has been a missed opportunity for a paradigm shift in the premises of economics and resulting economic policies" (Bina and La Camera 2011: 2314).

In the same vein, we contend that sustainable urban development, or sustainable urbanism, will not take place unless there is a radical shift away from the dominant city building paradigm (a paradigm that is closely linked to the evolving understanding of 'development' as the migration of people to urban life (Hann and Hart 2011)). In order to make this point we need to go back to the last true paradigm shift in the field of urban planning and design—that is, the Modernist project of the Functional City, as envisioned by the *Congrès Internationaux d'Architecture Moderne* (CIAM) in 1933 and advanced by Le Corbusier in 1943 with the publication of the *Athens Charter*.

3.1.2 The lasting paradigm of the Functional City

The Modernist project of the Functional City, which would become by and large the dominant paradigm of urban planning since the second half of the twentieth century, was concerned with achieving socio-economic progress and a better world through modernization. With regard to the design of the city, modernization meant a rejection of all past traditions of city making. The rational *progressivist* ideology of Modernist urban planning—exemplified by architects like Otto Wagner, Le Corbusier, Walter Gropius, or Mies van der Rohe—was a conscious reaction against, or a shift from the paradigm of the romantic *culturalism* of pre-Modernist urban planners such as Camillo Sitte, Raymond Unwin or Ebenezer Howard.[40]

In Europe, the CIAM manifestos of the early 1930s, and particularly the *Athens Charter* of 1943, established the rules to achieve the efficient and functional city. The dominant industrial paradigm of the time governed this conception according to the principles of "specialization", "standardization" and "mass production". The Modernist city, conceptualized as a solution of universal application, was envisioned as "a functional machine" with its essential urban functions, or

[39] As defined by the World Commission on Environment and Development (WCED) in the 1987 report "Our common future", also known as the Brundtland Report.

[40] The terms Culturalism and Progressivism were first suggested by Françoise Choay, in her 1965 celebrated book *L'Urbanisme: Utopies et Réalités* to counterpose two ideologies which have run intermittently through Western culture over the last two hundred years. Simply put, Culturalism respects past traditions and envisions the future as a circular, or spiraling process of incremental evolution (a cultural-artistic stance); while Progressivism envisions the future as a series of radical breaks with the past, set along a straight line of evolution (a scientific-technological perspective).

activities, broken down into four basic components: housing, work, recreation, and traffic (Le Corbusier 1929, 1943). These functional areas, individually planned by different specialists and occupying separate urban zones should be assembled together—like in an industrial process—in a comprehensive master plan by "value-neutral" and "apolitical" experts: the planners. This technique was later designated by "zoning" and adopted internationally.

Almost simultaneously, in the USA, a social-science model for planning emerged from the Chicago School. The planning process, grounded in rigorous social analysis, was defined as a comprehensive, rational model of problem-solving and decision-making to guide state intervention. Optimization of resources' allocation should be done according to "objective standards" for planning, which were seen as universally applicable to solve all problems of urban development wherever necessary (Hall 1996).

The coalescence of these two models with a robust post-World War II military-industrial complex had huge repercussions on the way cities would grow thereafter. Both the massive post-war urban reconstruction effort in Europe and the vast suburbanization project in the USA, fuelled by the G.I. Bill, were zealously planned and developed according to the principles of the Modernist Functional city. The sheer scale and span of such operations streamlined not only planning and development processes and its institutional channels but also the entire construction industry, the financing mechanisms of the banking system, and the urban policy of municipalities. These were the unquestionable indicators of a true paradigm shift in city planning and urban development, whose spatial materializations were more or less enthusiastically embraced by a new middle class of urban consumers.

Before this shift, pre-war urban development was essentially carried on through "organic" additions to the existing urban fabric; and town planning, with design at its heart, was not clearly distinguishable from architecture—it was "architectural design on a larger canvas", a canvas made of streets and plazas (Taylor 1998: 17). Suburbs also differed in important ways from modern suburbia; they were more compact, morphologically singular, contiguous to the central city, and in general more income-mixed (Ames 1995). Therefore, the Modernist Functional city and its mass-produced leapfrogging suburbs, easily accessible by mass-produced automobiles, were a groundbreaking innovation in urban life and lifestyle.

It is today widely acknowledged that the Modernist principles of specialization, standardization, and mass production applied to city planning have had severe and everlasting impacts on the character of urban spaces, entire neighbourhoods and whole regions (Calthorpe & Fulton 2001). Ultimately, Modernist city planning gave way to countless oversimplified monofunctional urban areas rigidly separated by zoning; thoroughfares that serve no other function than the moving of vehicles from zone to zone; and, more generally, urban systems fully compliant with "unavoidable" increases in car dependency and consequent urban congestion, followed by highway building and suburban expansion, ensued by more congestion, further highway building and more suburban expansion (Newman & Kenworthy 2003)—a process of metastatic growth that became known as "urban sprawl".

Meanwhile, a parallel debate was ongoing since the late 1960s, exploring the impact of human development (including urbanization) on ecosystems and the environment (Vaz 2012). Debates on the limits to growth and later on the need for sustainable development (Meadows et al. 1972; WCED 1987) raised fundamental questions about the mainstream economic paradigm, which in turn influenced and was being influenced by urbanization trends around the world. However, the Modernist turn was not only zoning the territory according to urban functions; through sectoral specialization, it was also sharpening the divide between disciplines, instituting a range of separate,

specialized professional areas of planning activity, such as traffic engineering, rural engineering, urban planning, regional planning, landscape architecture, geography, sociology and so on. Thanks to the tight disciplinary and sectoral separation of knowledge, the shortcomings of the Modernist paradigm in terms of sustainability were not seen—or seen as sufficiently significant—to challenge the dominant paradigm in city planning and urban development. As we shall see, the failure of the ecological, environmental (and subsequent sustainability) discourse to enter the world of urbanism in the 1970s had important consequences and led to lock-in effects both in Europe, first, and presently in China.

3.1.3 Reactions (or tentative shifts): three manifestos

In response to the functionalist ideology, the universalism, and the anti-historicism of the Modern movement—and also against the urban and suburban environments thus created—a reaction started emerging in the 1960s. Criticism of the Modernist city was particularly prolific in North America during the 1960 and 1970s.

On one hand, the procedural aspects of rational top-down planning were harshly criticized as authoritarian, and a move toward more effective community participation in planning processes was advanced, first by Paul Davidoff then by others, with the concept and practice of "advocacy planning," according to which the planner should act more like a mediator between diverse stakeholders than like an elitist "apolitical" expert in charge of the execution of a master plan (Davidoff 1965).

On the other hand, a growing concern with humanizing a city that was being drastically transformed by post-war sweeping schemes of urban renewal, ripped apart by huge engineering works, especially highways, and voided by mass-suburbanization, made way for a vehement reaction among those concerned with the future of the urban environment. The most eloquent critique—in fact a true manifesto against the Modernist principles of CIAM—was launched in 1965 by Canadian writer and political activist Jane Jacobs. Her celebrated book *The Death and Life of Great American Cities* was, and still is, a persuasive portrait of the social success of the old urban patterns rejected by Modernism. She criticized the "separation of uses" doctrine at the core of zoning, while advocating mixed-use neighborhoods with wide sidewalks, narrow streets, short blocks, and plenty of pedestrian connections (Jacobs 1961).

In Europe, the oppositional critique to the Modernist city came from what became known as the Movement for the Reconstruction of the European City. The origins of the movement might be traced back to a collection of articles from a number of European historians and architects, which were assembled and published in 1978 by a Luxembourger architect and urban planner named Léon Krier. The book was seen as a manifesto, putting forward a theory that "deconstructs the functionalist system founded by Le Corbusier and institutionalized by the CIAM" (Delevoy 1978: 15).[41] Krier, the most vocal representative of the movement, came out in 1980 with his own *Manifesto: the Reconstruction of the European City or Anti-Industrial Resistance as a Global Project*, and in 1981 published another influential article in the magazine *Oppositions*[42] entitled "Forward comrades, we must go back." In his manifesto, he advocated the study of the best examples of pre-

[41] Robert Delevoy also claims that the book "acts as a guide, forms a corpus, develops a method [and] puts forward a theory, the absence of which has been cruelly felt since the decade 1930-40. It suggests a practice, which may well fill the gap created in 1960 by the setback of Brasília: a masterly demonstration and a striking failure of a way of town-planning thought." (Delevoy, 1978:15)

[42] The magazine *Oppositions* was published from the early 1970s until 1984 by the Institute for Architecture and Urban Studies in New York, whose members included architects Peter Eisenman, Kenneth Frampton, Manfredo Tafuri and Rem Koolhaas.

industrial urbanism and the "reconstruction of the old city with its social, typological and functional complexity (...) to serve as a model for the transformation of suburbs into true and proper centers" (Krier 1982: 105).

The idea of "neo-traditional" urban planning and design evolved during the 1980s in the United States chiefly inspired by Jacobs's ideas, by the theoretical models proposed by Krier, the "pattern language" theory of Christopher Alexander[43] and by the founding proposals of late nineteenth century British urban planner Ebenezer Howard.[44] The two most well known North American neo-traditional approaches to urban planning are the Pedestrian Pocket proposal of architect Peter Calthorpe (1989), which evolved into the present-day operational concept of Transit-Oriented Development (TOD); and the model of Traditional Neighborhood Development (TND) advanced by architects Andrés Duany and Elizabeth Plater-Zyberk (1990), which evolved into the contemporary movement, theory and practice of New Urbanism.[45]

Proponents of these two concurrent approaches to planning eventually coalesced into a unified group—the Congress for the New Urbanism (CNU)—in 1993, and three years later came out with their own manifesto: the *Charter of the New Urbanism*.[46] Since its inception, CNU set out a vigorous campaign against the Modernist principles deeply embedded in the planning system, directly challenging conventional suburban development (sprawl) as sanctioned by existing zoning laws, and advocating new ways of planning the neighborhood, the city and the region. The movement has been attracting a growing number of professionals from diverse fields, as well as the support from US public officials, politicians, citizen activists, developers and realtors (Balula 2010).

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[43] In *A Pattern Language* Christopher Alexander et al developed a linked hierarchy of 253 patterns ranging in scale from the region to the details of houses' interiors. This hierarchy rests on the ecological notion that patterns and formal entities are not isolated but interwoven into a coherent whole, like in a fractal—allowing design to integrate across all scales of intervention, from architectural details to regional planning.

[44] Ebenezer Howard (1850-1928) was the author of *To-Morrow: A Peaceful Path to Real Reform* (1898) and the founder of the Garden Cities Association, today known as the Town and Country Planning Association. He advanced the idea of "garden-cities"—administratively independent and mixed-use new-towns of limited size, planned in advance, and surrounded by a permanent green belt of agricultural land. His garden-city diagrams became widely known and extremely influential to this day. In his lifetime two garden cities were planned and partially developed (Letchworth and Welwyn). Both served as models for the post-world-war II New Towns implemented by the British government.

[45] Calthorpe's Pedestrian Pocket—the building block of TOD—is more regional in scope than TND. It entails the restructuring of suburban regions along mass-transit lines, with medium-high density mixed-use "pockets" of employment, stores, recreation, civic services and affordable apartments adjacent to transit stops, surrounded by less dense residential development within a quarter-mile to one-half mile (400 to 800 m) walking radius of the mixed-use hub (Calthorpe, 1989; 1993). TOD constitutes a serious attempt to provide a sustainable alternative to predominantly car-oriented suburban sprawl. TND, on the other hand, is more concerned with the elaboration of design guidelines (or urban codes) in order to accommodate suburban growth in the manner of towns. It challenges current zoning codes and favors traditional patterns of placemaking that respect human scale and promote walkable urban environments.

[46] A summary list of the key principles of the Charter include: polycentric metropolitan regions that are composed of cities, towns, and neighborhoods with identifiable centers and edges; compact development that preserves farmland and environmentally sensitive areas; infill development to revitalize city centers; mixed land uses rather than single-use areas; transit-oriented development; interconnected streets, friendly to pedestrians, often in grid-like patterns; the use of street, block, and well-matched building typologies to create coherent urban form; well-designed and well situated civic buildings and public gathering places; discreet placement of garages and parking to avoid auto-dominated landscapes; high-quality parks and conservation lands used to delineate and connect neighborhoods and districts; and architectural design that shows respect for local history and regional character (based on Katz, 1994).

In the late 1980s, neo-traditional urbanism was concurrently emerging in Europe and, not surprisingly, with particular prominence in Great Britain. After all, the originality of New Urbanism laid in a close study and contemporary reinterpretation of two old British regional planning and urban design theories: Ebenezer Howard's garden-city, and Raymond Unwin's streets and plazas. In reaction to the poor design of most post-war development in England, which was "widely criticized for its monotonous uniformity and its lack of local character" (Ellin 1996: 81) a renovated interest in pre-Modernist design principles and processes emerged in the late 1980s, mostly as a result of a campaign initiated by the Prince of Wales, and later promoted by the European Urban Renaissance movement.[47] Concurrently, in 1999, the UK's Urban Task Force, chaired by the British architect Richard Rogers, issued a report entitled *Towards an Urban Renaissance*,[48] which was influential in the re-writing of a new generation of planning policy guidance relating to the design quality of new residential environments (Tiesdell 2002).

Given an increased awareness of the intertwined problems of global warming and fossil-fuel dependency, over the last two decades New Urbanism diversified its range of concerns and is now engaged in environmental, equity and sustainability issues; it "has gone from a design movement recognized primarily for good placemaking, to one that is perceived as beneficial to the environment" (Steuteville 2008: 2).[49] Concurrently, an increasing body of research is showing that New Urbanism developments are energy-efficient and contribute to reduce greenhouse gas emissions (New Urban News 2008). The appeal of New Urbanism's Smart Growth policies[50] is that they are directly concerned with spatial transformation and the politics of place. New Urbanism, thus, has the ability for recovering the traditional domain of planning practice: that of envisioning *human settlements*—and not functional urban growth machines—as the main focus of planning. This change comes closer to the common notion of paradigm shift.

At first rebutted in American and European academic circles as an "outcome oriented" planning process catering to the real estate business, New Urbanism was nevertheless recognized early on as "a counter-project to post-industrialism" (Duham-Jones 2000) and as a promising "new direction in planning theory"; a new guiding ethic for planning action, which besides a normative content—like equity planning—also has a substantive content: spatial planning (Fainstein 2003).

Given its frontal challenge of the dogmas of Modernist urbanism and the Functional city; a growing authority on many different fields; an integration of diverse disciplines; and a determined activism that is the hallmark of the movement, New Urbanism and Smart Growth stand out today as the potential paradigm shift in urban planning—a credible alternative, arguably capable of inverting the unsustainable path of contemporary urbanization.

However—as long as urban growth continues to proceed through exclusively residential areas for discrete market segments; exclusively commercial areas in auto-oriented shopping malls; exclusively business areas in isolated office parks; and exclusively traffic-oriented thoroughfares—we are still

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[47] The European Urban Renaissance movement aims at developing the European cities according to the principles of the traditional city and New Urbanism. It was launched on 1996 with the exhibition *A Vision of Europe* at the Second Bologna Triennial of Architecture and Urbanism.

[48] The "Rogers Report", as it became known, examined the question of how 4 million projected new homes over 25 years might be accommodated in the UK without further encroachment into the green belt.

[49] Since 1993 the CNU has met regularly every year in a different city, and established a number of task forces and initiatives to study and work on a wide range of related issues, such as the environment, education, social equity, implementation, transportation, and inner-city revitalization.

[50] "*Smart growth* is a general term for policies that result in more compact development. Smart growth is an alternative to dispersed, automobile dependent development outside existing urban areas, often called *sprawl*. *New urbanism* generally refers to smart growth policies implemented at the local or site scale" (Litman, 2011: 1-2)

unquestionably immersed in the Modernist paradigm, despite its empirical failure in terms of sustainability. As New Urbanist Andrés Duany has asserted with respect to the urban planning system, it seems that "what is assumed to be a neutral, market-responsive and technocratic system is actually heavily biased toward a certain model [of urban growth: sprawl]" (Duany 2002: 252). As long as established norms, policies and institutions, as well as conventional reasoning in urban matters stay bounded by the Modernist turn, a New (sustainable) Urbanism will continue to be a paradigm shift in the making—like it has been since the days of Jane Jacobs, almost half a century ago.

3.1.4 Urbanization trends in Europe

Typically, manifestos are strong reactions against accepted theories or worldviews; they denounce a major problem and offer a fresh perspective or advance new solutions in order to solve it; they also try to summon a given community to action, in line with established objectives or principles. In a Kuhnian sense, manifestos—when supported by a considerable number of people—have the potential to generate change and the re-evaluation of prior assumptions, i.e., they might be at the origin of a paradigm shift.

Persistent failure to solve a major problem (unsustainable urban growth through sprawl) has challenged the accepted theory of the Functional City and, as we just saw, a few manifestos have already shaped a strong movement for a new (sustainable) urbanism as way for turning urban growth machines into human settlements. Among European planners and decision makers there is growing recognition that urban sprawl—as promoted by the Functional City—represents a major threat to sustainable development, as it increases energy consumption and congestion; makes the provision of services difficult; leads to spatial segregation and social exclusion; results in biodiversity loss and depletion of natural resources; and contributes to the economic decline of the traditional city centre (Couch, C. et al, 2007: 229; EC-DGRP, 2011: 27). Moreover, urban development and agriculture compete for the same land and sprawl typically displaces agriculture from fertile (but cheaper) soil to low-quality land, requiring more water and fertilizers (EEA, 2006: 31).

With regard to urbanization trends in Europe, sprawl is also often the side-effect of social or economic policies, such as taxes and subsidies to promote economic development through urbanization, without a proper definition of *where* it should take place (Couch, C. et al, 2007: 229). This is usually coupled with weak spatial planning systems and/or unsustainable urban development models (e.g. zoning, intermunicipal competition) that favour private, short-term interests over the long-term public good (EC-DGRP, 2011: 26).

Numerous planning policies have been devised—first at national level and more recently at EU level—to tackle sprawl, and some cities, mostly in Northern countries, have succeeded in this effort. The majority of European cities and metropolitan regions, however, still need to put in place effective measures to combat the problem and its externalities. This constitutes a major policy challenge, considering that even if core cities' development strategies tend to combat sprawl, suburban municipalities are likely to foster it (Couch, C. et al, 2007: 223-4).

From an environmental standpoint, and in line with New Urbanism's concerns, the Environmental European Agency (EEA) has recently acknowledged the importance of merging the ecological discourse with that of urbanism, with a stress on nature and biodiversity. Urbanization has profound impacts on biodiversity: it consumes rural land, destroys or fragments natural habitats, increases indirect human impacts (e.g. noise and pollution) and reduces the amount of open space for human leisure and enjoyment (EEA, 2010: 6). Moreover, the impact of urbanization is felt far beyond the urban boundaries—a phenomenon associated to the concept of "ecological footprint" of a city.

As EEA recognized, good urban design is critical for promoting biodiversity[51] because the footprint size is strongly determined by urban form.[52] Therefore, to achieve significant change in terms of urban sustainability, it seems essential to integrate urban design and biodiversity concerns into spatial planning instruments at the local and regional scales of intervention, as these are still mainly shaped by the Functional City paradigm.

A lingering issue is how to deal with the lock-in effects of current spatial patterns of extensive suburbanization. In this respect, the International Society of City and Regional Planners (ISOCARP) identified five key areas where regional and local policies are more likely to contribute to low carbon footprint cities: (i) spatial planning policies;[53] (ii) compact city strategies;[54] (iii) urban-rural strategies;[55] (iv) local energy generation;[56] and (v) transport.[57]

3.1.5 Urbanization trends in China

Nowhere like in China has the concept of Eco-city been used so often as a proxy for a new model of sustainable urbanization. According to a 2010 survey by the University of Westminster, China is currently building more "low-carbon" eco-cities than any other country (Joss et al, 2011) and a wave of media coverage has been advertising the Chinese eco-city phenomenon over the last few years. As recently reported by Xinhua News Agency, however, Housing Vice Minister Qiu Baoxing recognized that "the eco-city concept has been overused in China, and some projects actually damaged the environment [while o]thers failed by their blind adoption of foreign models" (MacLeod, 2012). Indeed, some eco-city projects appear to have been mere promotional gimmicks of developers and government authorities eager to attract foreign investment and have stalled or remain on paper—like Dongtan, near Shanghai, a joint initiative of the Shanghai government and British design firm Arup, or Wanzhuang, near Beijing, another joint venture with Arup (Sapa-AFP,

[51] "Urban design describes the location, physical form and structures of our cities. It enables certain functionalities and lifestyles. Proper urban design can thus reduce the need for additional urban land-take and fragmentation. It can, at the same time, penetrate the city with greenery and promote biodiversity. Creating and improving green areas, revitalising brownfields, greening roofs and walls, at the same time as maintaining urban density and compactness, maximises the amount of ecosystem services delivered within cities and [reduces] the ecological footprint" (EEA, 2010: 4)

[52] ""Urbanisation is the increase of urban population, combined with urban densification and/or expansion and fragmentation of urban area. It usually increases a city's ecological footprint and creates impacts on biodiversity and the environment in general. However, the extent of the footprint depends on the form and pattern of urbanization" (Ibid)

[53] "Spatial planning policies that integrate land use, transport, energy and waste planning, that take into account biodiversity and species conservation concerns as well as the efficient management of water resources, and that embrace all three aspects of sustainability, the social, the environmental and the economic" (ISOCARP, 2010: 24)

[54] "An emphasis on the compact city embracing higher densities (but not necessarily high rise), mixed uses, a structure that embeds efficient, integrated public transport, a defined and protected system of open space, and a defined urban edge to prevent sprawl" (Ibid)

[55] "Planning strategies for cities that are in the context of those for the wider region and extend to the rural hinterland" (Ibid)

[56] "As part of a move away from wasteful, centralized energy generation, a new emphasis on energy planning at the city and neighborhood scale" (Ibid)

[57] "Nodes for all modes (or modal interfaces) – the future of transportation depends on the seamless transition between modes of transport. The ... livable city of the future [has] strategic nodes of exchange in the transportation network ... fully integrated into most if not all *urban living areas* [of a given dimension/density], where transport modes intersect, and where people can transfer from foot to bike, from bus to train, and between all other combinations" (ISOCARP: 2010, 21)

2012). As Leaf and Hou (2006) have noted, “low-carbon” is still an unclear concept, and is often used simply as a label, sometimes even for projects that are, in fact, “high-carbon”.

On the other hand, Tianjin Binhai, at about 1 hour by fast train from Beijing, is now being touted as a new model for urban sustainability, fundamentally different from other eco-cities. A joint development between the Chinese and Singaporean governments, Tianjin eco-city was started in 2008, will be finished in 2020 and is intended to house 350,000 people in an area of about 30 km2, the size of half Manhattan (Bardsley, 2012). On a recent oficial visit to the city, Singaporean Prime Minister Lee Hsien Loong said that it should be replicable and scalable to other cities in China (Xinhua News, 2012).

According to The National, Tianjin eco-city is different from other experiments on eco-cities in two major ways. First, it is said to promote most New Urbanism principles, like compactness and accessibility, walkability and public transport, in-situ jobs and mixed-income housing, well located parks and public buildings like schools and hospitals, as well as renewable energies and energy saving buildings. Second, it is said to adopt an incremental approach to sustainability. Despite the scale of the operation, promoters are reportedly taking a “step-by-step” approach and are “trying to achieve what is realistic” by means of “slight improvements on a very large scale”[58] (Bardsley, 2012). Conversely, it was recently announced that a series of groundbreaking technology trials will be carried on the city. General Motors will use Tianjin to test its electric driverless cars; Philips will try a low energy lighting system for public spaces; while Envac, a Swedish firm, will develop a vacuum suction underground system for garbage disposal (Moore, 2012).

However, despite claims of low-carbon targets having been set for almost 200 Chinese cities, according to Yue and Nan (2011) only about 20% of those claims are genuine. In effect, evidence shows that urban sprawl is and will continue to be the rule. Current and predictable trends indicate that China’s fast urbanization will continue to follow a spatially dispersed pattern;[59] moreover, pressures of dispersion are even expected to intensify.[60] Current urbanization policy is one of promoting growth in “all cities and small towns”, and is leading to increasing sprawl externalities, as well as spatial dispersion of infrastructures and services (Kamal-Chaoui et al, 2009).

Conforming to the Functional City zoning criteria, urban sprawl in China proceeds today mostly by juxtaposition of segregated land uses. As well documented on numerous New Urbanism publications segregated land uses not only aggravate the urban footprint by increasing energy and resources demand but also entrench social segregation by income and differentiated access to urban services. This is true for many Chinese suburban areas and particularly evident on former rural villages and towns now engulfed by suburban sprawl (*chengzhongcun*).[61]

In a rapidly changing society, urban planning in China is shifting from absolute state control to a practice carried out by numerous, diverse private players. There is a range of new actors on planning

[58] Quotes are statements of the Tianjin Eco-city project's chief executive Mr. Ho Tong Yen, a Singaporean government official

[59] “Overall, the trend points to China heading toward a dispersed urbanization pattern with more pronounced expansion in the number of midsize and small cities” (MGI, 2009: 17).

[60] “Rapid urbanization since 1990 has generated serious pressures, many of which are linked to the dispersed model of growth China has followed as a result of current policies. We believe these could intensify in the future” (MGI, 2009: 21; see also Lin 2007).

[61] “The phenomenon of *chengzhongcun* (literally, the “village in the city”)—with often high density, poorly built structures served by substandard infrastructure and roadways—has been growing rapidly as administratively village lands become encapsulated within urban territories of outwardly expanding cities” (Leaf and Hou, 2006: 558).

processes, among them "land development companies, private and collective companies, and domestic and foreign investors, as relatively autonomous owners of capital" (Leaf and Hou, 2006: 556). On the other hand there is potential for the emergence of "civil society", as embodied in citizens' groups, professional organizations, etc. How this will contribute to a fundamental change in top-down planning policies remains to be seen.

Recent planning policies in China, emanating from the Ministry of Construction, include the concept of "compulsory content", which shows some concern with the environment and historic urban areas, while introducing specific urban design rules for more sustainable urban environments. "Compulsory content", however, is seen by some as strengthening central government control over urban planning.[62]

3.2 Paradigm shifts in China • by Qi Xiaoxu and Yang Zhiyou

3.2.1 Urbanization Paradigm Shifts

Ever since China's Reform and Opening-Up, urbanization has become an important means of catalyzing the country's economic development and transforming the mode of economic growth in China. The drivers of China's urbanization are diverse and intricate and not merely the outcome of industrialization and economic development. China's urbanization is also driven by top-down political and administrative factors. China's urbanization lags behind the industrialization process, which is simultaneously influenced by such factors as natural conditions, economic development levels, and the institutional environment. The particularity of the dynamic mechanism of China's urbanization has resulted in an urbanization path inevitably distinct from those of other countries, shaped by various features unique to China, and also facing some intractable institutional barriers and social conflicts. These barriers and conflicts include the biased focus on the quantity rather than the quality of cities, a low level of urban-rural integration (a wide gap between the development levels between urban and rural communities), the inability of rural labor force to receive the same social welfare as urban residents due to the *hukou* system and enjoy the other benefits of urban residency, and imbalances in the regional coordination of urbanization. It is essential or China's socioeconomic development to solve these conflicts in the further process of urbanization and to plan a new and improved path for urbanization.

In the early era of the Reform and Opening-Up, China's urban development path was uncertain and some local governments simply imitated foreign examples without considering China's specific socioeconomic, political and environmental characteristics, which has led to problems emerging in the later periods. It is exactly these problems that are handicapping the further improvement of China's urbanization. It now appears that China must find an urbanization pattern that suits itself, and exploring how the urbanization paradigm has shifted or evolved in China is thus a fundamental task. Multiple scholars have evaluated these issues, which we proceed to summarize.

3.2.2 Study on the development paradigm of China's cities by He et al. (2005)[63]

[62] *Compulsory content* includes "the designation of ecologically sensitive areas, seen as green or open space (referred to as 'green line' areas), historic preservation areas ('purple line'), and major infrastructure and public facilities; it also prohibits the planning of ... 'super squares' (*daguangchang*—defined as any public square in excess of two hectares) and 'broad roads' (*kuang malu*—any road with a red line width greater than 80 meters) in any cities" (Leaf and Hou, 2006: 570).

[63] He, Yimin, Ying Fan and Chun Fu. (2005). Study on the development paradigm of China's cities. *Social Science Research*, 1, 49-54.

According to He et al. (2005), there are three paradigms that have emerged in the formation of China's cities: the individual development type, dependent development type and mutualistic symbiosis development type.

Individual development paradigm

According to the individual development paradigm, in a certain space/area a city develops independently in a relative enclosed environment without social and economic interactions with other cities, a condition which has existed in different periods in China due to various reasons.

Under the planned economy, the development of the city revealed a certain kind of interdependence that was nonexistent in agrarian society. Even though spatial clustering of cities appeared in some areas, this kind of assemblage was merely administratively planned rather than economically driven and hence is called "administratively planned city clusters". China's urban system exhibited a closed trait and the level of integration of Chinese urban system was relatively low.

After the Reform and Opening-Up and during the transition from planned economy to market economy, the independence of many major cities persisted due to cultural and historical barriers, technological limitations in traffic and communication, the imbalance of regional economic development and imperfections of the early market economy. In the early 1980s, China implemented a policy called "organizing economic activities with big cities as the centers", and 14 cities were enlisted as key cities. The surrounding counties of the key cities were merged into them and therefore many regional metropolises enjoyed fast development and the connections between cities in an area were enhanced. However, it should be stressed that such connections were unequal and the integration of cities was far from being achieved. On the contrary, the imbalance exacerbated to some extent issues of regional protectionism, economic barriers, and the like.

Meanwhile, the independence of China's cities emerged in a way that they had greater connections with foreign cities than their own domestic counterparts. Economic connection and cooperation among China's cities were especially inadequate. For example, a few Chinese cities all wanted to attract the same foreign investment for economic growth, triggering unhealthy competition and discouraging intercity cooperation.

Dependent development paradigm

The dependent development paradigm refers to the development of close economic ties among cities, but with inequality existing in such relations. There are dominant and subordinate cities. This paradigm has come into being rather recently in China.

The relations between China and the rest of the world have become increasingly compact since the Reform and Opening-Up. In order to accelerate economic development, China has taken more imbalanced policies, and the coastal regions have enhanced development due to the geographic advantages. However, such policies have led to a more severely imbalanced development pattern across China. Simultaneously, since China is still in the primary phase of urbanization when bigger cities are the focus, the majority of all kinds of resources are absorbed into megacities. In 1980s-1990s, large and mega cities in nearly all regions of China developed at a stunning speed and these cities later connected their surrounding small- and medium-sized cities.

It should be noted that during this period, the city system reflects a pyramid shape and the main economic relations are dominant-subordinate ones, featuring much inequity. For example, the Pearl River Delta is dependent on Hong Kong, the Yangtze River Delta is dependent on Shanghai and the small- and medium-sized cities in Chengdu Plain are dependent on Chengdu. Due to such inequity, funding, know-how, labor, goods, information and technology are all gathered in these kernel cities.

During the decision-making process by governments in these large cities, the interests of their surrounding minor cities are scarcely taken into account. In competitions among cities, there minor cities can only choose to enhance the connections with major cities and must endure their submissive status. Such a situation is harmful for the further development of cities in the whole region, especially in a globalized world. To some extent, globalization brings homogenization with it, and the control and influences of major cities over minor cities will possibly result in more functional similarities of the later, and minor cities' dependence on major cities can only be intensified.

Mutualistic symbiosis development paradigm

The mutualistic symbiosis development paradigm refers to cities that are connected interactively and complementary advantage, mutual benefit, long-term cooperation, joint and equal development are emphasized. Such a paradigm is currently being advanced in China by academics and planners and should hopefully enjoy greater acceptance in China.

Since the middle and later periods of the 1990s, with the further opening up of China, the country has made more efforts in reforming its previous planned economy. The transformation of the planned economy to a market economy has evolved into a new trend, administrative segmentation has had to accommodate the market, and a series of institutional changes have taken place, such as reform of the household registration system, the housing system, and the urban welfare system. These changes forced cities to embrace opening-up and interactive development. The methods of resource allocation and regulation have turned to the market rather than relying exclusively on administrative planning, and the impact of administrative divisions on the regional economy has gradually weakened.

With the accelerated process of economic globalization since the 20th century, any single city seems weak in the increasingly fierce international competition. Together with economic globalization, a new phenomenon of "regional economic integration", and how to improve the comprehensive competitiveness and core competitiveness of the city has become a major issue. However, to improve competitiveness, solely relying on the resources and factors of production within the city has been far from enough, and a city must seek cooperation with other cities or even other regions. For example, Guangzhou, Shenzhen, Zhuhai and other cities located in the Pearl River Delta are engaged in collaboration with Hong Kong. The cooperation has resulted in the creation of 16 cities in the Yangtze River Delta. Besides, Dalian, Yingkou and other nearby cities are as well seeking the integration of their human resource markets.

3.2.3 Study on China's new paths of industrialization and urbanization by Luo and Zhang (2004)[64]

Industrialization refers to the historical process of modern industries taking the dominant role in a nation's economy. It provides production tools, technical equipment and raw materials for various sectors of the national economy and daily industrial products for the people. Industrialization is also the most direct impetus for urbanization. Urbanization refers to the process of human production and transformation of lifestyle from rural type to urban, and is reflected by the immigration from the rural areas to the cities and the continuous development and improvement of the cities. The cities act as the carrier of industrial development, and industrialization and urbanization are tightly associated with one another. The two processes restrict, influence and meanwhile bolster each other. Although the city emerged prior to industry, the accelerated development of the city only took place after the industrial revolution.

[64] Luo, Weikun, Chunhong Zhang. (2004). Research on the way to new pattern industrialization and the mode of Chinese City Development. Chongqing Architecture, 1, 22-25.

The new path for industrialization is based on the summary of the experience of the traditional path for industrialization and China's heavy-industry-prioritized path for industrialization before the Reform and Opening-Up. Its essence lies in fully activating the "No. 1 productive force" of science and technology, and well balancing the economic, social and environmental benefits for sustainable development. Consistent with the new path for industrialization, there exists the accompanying new path for China's urbanization, which includes the following aspects (Luo and Zhang, 2004).

Urban-rural integration

The optimal urbanization of China should not follow either of the following paths. One is the path of traditional industrialization, which heavily relies on the exploitation on the farmers and destruction of agriculture for the primitive accumulation of capital. The other is the strategy conducted in China prior to the Reform and Opening-Up, which prioritized heavy industry and ensured the primitive accumulation of capital from agriculture to industry with the policy of state monopoly over purchase and marketing and the stringent household registration system. Urbanization should allow rural residents to immigrate into the cities in an orderly manner, in order to elevate the efficiency of rural production, facilitate the creation of urban jobs, promote the urban economy and technological prosperity, and emphasize development of tertiary industry. Only in this way can the social, economic and cultural integration of rural and urban areas be achieved and can the rural areas enjoy the same level of development as the cities.

Urban ecologicalization

Urban ecologicalization is one of the fundamental differences in urbanization between the new and traditional industrialization paths. Based on the local natural environment and ecology and other related technical factors, urban ecologicalization can artificially create a comfortable living environment and meanwhile control and reduce human destruction of nature and the predatory use of natural resources. It regards the people, the city and nature as a unified organic entity, and strives to achieve balance between the urban demands on nature and the urban contribution to nature. Hence, a "circular economy" should be advocated in China's urbanization. Urban ecologicalization can raise the living standards of the people and avoid the destruction of the natural environment caused by human's predatory exploitation of the Earth. Compared with the traditional economy, circular economy is more efficient, requires lower energy consumption, discharges less pollutants and is more beneficial to the urban ecology. This is the economic form that matches China's new industrialization and urbanization path.

Urban digitalization

Urban digitalization is an inevitable outcome of the transformation from an industrial society to an informational society. Currently, China's industrialization is yet to be completed, however, in an era of economic globalization and the knowledge economy, the need for developing informatization is urgent, as informatization and industrialization can further catalyze one another. Hence, urban digitalization is irresistible. The concept of the "Digital City", also known as the "Network City" or the "Smart City", or more precisely as the "Information City", refers to digital, information and network technologies penetrating into all aspects of the city, creating a virtual model of a real city by the digitalization and networking of data on urban infrastructure, land use, environment, architecture types, resources and demography, socio-economy, etc., in order to facilitate the sustainable development of cities.

3.2.4 Study on the development paradigm of China's cities by Liu (1999)[65]

Small-sized cities and towns

[65] Liu, Yishu. (1999). Debate over the paradigm of China's city development. Urban Issues, 4, 12-14.

The development mode of China's small-sized cities and towns has been shaped by certain historical conditions. After 1979, the reforms on economic structure were first implemented in the rural areas, and the policy of restricting the size of big cities and advocating the development of small-sized cities and towns was enacted. In a couple of years, the number of small-sized cities and towns soared and township enterprises flourished, resulting in a new rural-urban structure. The debate of this development paradigm is still ongoing, focused on the combination of small-sized cities and towns with such issues as urban-rural relations and urban road construction. It still remains difficult to evaluate the advantages and disadvantages and overall influences of this urbanization model.

Medium-sized cities

Medium-sized cities, as the socio-economic, political and cultural center of a certain area, perform a crucial role in China's city system. Considering the various "modern social diseases" in metropolises, the resistance to urbanization derived from the traditional agricultural society, and environmental limitations, some scholars have advanced the view that development of medium-sized cities can act as a more viable choice for China's urbanization and to achieve the modernization of China's urban and rural social structure. Advocates have stressed the flexibility and the role of a bridge linking small and big cities through medium-sized cities. Medium-sized cities, on one hand, overmatch the small ones regarding economies of scale, and on the other hand, can very likely get rid of the "urban diseases" in metropolises.

Metropolises

In the early 1980s, some scholars proposed the ideas of metropolitan development, and they proposed that higher efficiency and greater profits came with more centralized economic activities. Hence, metropolitan development should be prioritized in order to realize the modernization of China considering the general dynamics of city development and the country's basic conditions. They considered that metropolises would reveal future development patterns, which was reflected through the ascending proportions of the population in big cities based on national data and in the aggregated urban data. Urbanization is a process of continuous development of metropolises and small- and medium-sized cities transforming into metropolises. Urbanization, as the direct consequence of industrialization, is symbolized by the development of major cities in the primary era and only metropolises can sharply increase social and economic benefits. In a developing country such as China, the economic, social and cultural leading functions of metropolises should be emphasized and performed with reasonable scale control.

In sum, the current paradigm of China's urbanization has merit especially considering its historical background. Such an urbanization path has been meaningful to the development of China's cities and will continue to influence their development. However, the paradigm itself should also evolve when some regions have reached a bottleneck in economic development. In fact, there are already numerous government officials and scholars who are aware of the importance of the endogenous development of cities, however, such ideas have not yet been put into actual practice. The main obstacle is the current political achievement assessment system of China, which is heavily focused on GDP. Nevertheless, as China improves the evaluation methods and enhances its monitoring capacity, more and more prudent strategies for urbanization will be adopted. Blind competition over foreign investment will most likely diminish. It should be noted that the endogenous development paradigm does not suggest rejection of foreign capital. Instead, it points out the deficiency of sustainability and the high level of risk in the current urbanization paradigm. Only when these issues are fully realized can the government departments choose an appropriate growth path for cities and improve the development environment for the city's future prosperity.

3.2.5 Economic Paradigm Shifts

Economic system

Ever since the New China was founded in 1949, the economic system of China has undertaken paradigm shifts several times, with consequent impacts on urbanization trends and thinking. Generally speaking, the process has been a diversity-uniformity-diversity transition. The following four periods basically depict the metamorphosis of China's economic paradigm after 1949, and Fig. 6-1 reveals the accompanying changes of the urban population proportion of China during the four periods from 1949 to 2012.

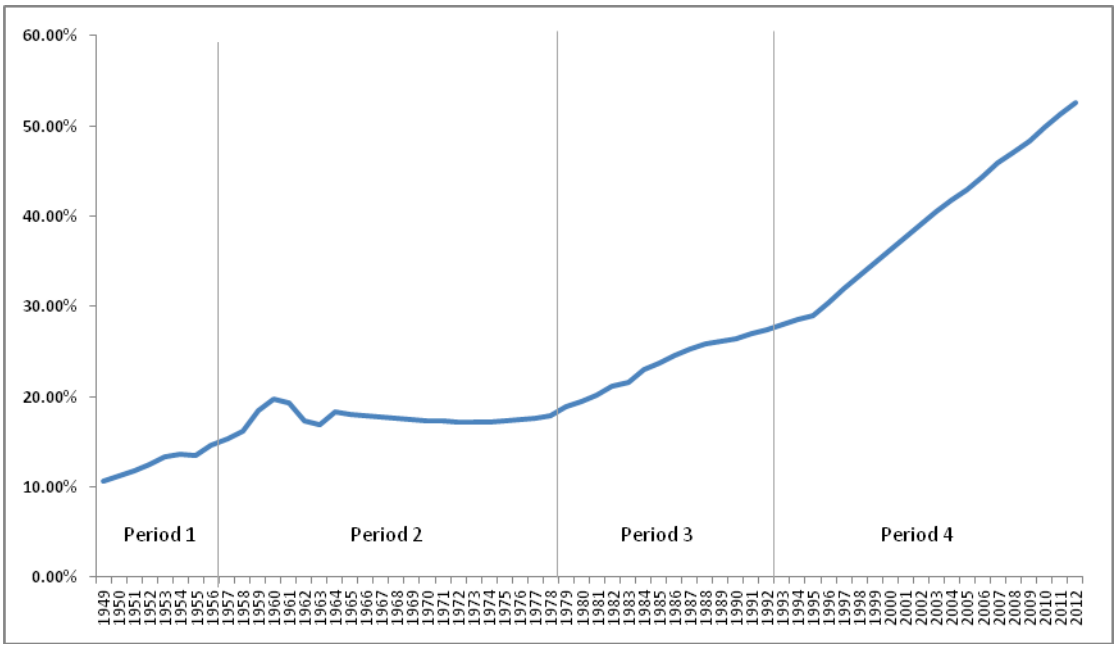

Fig. 6-1: Urban Population Proportion of China (1949-2012)

1949-1956: Shift from a diversified economy with the predominance of the socialist public sector to a single-structured public ownership and planned economy (Period 1)

During this period, "bureaucratic capital" (private capital gained through government connections) was confiscated and the land reform was implemented in order to revive and develop agricultural production with the government taking control of the economy. Additionally, reform of public ownership of agriculture, trades and industry and commerce (the Three Reforms) were substantially completed, in order to consolidate the socialist system. This period's economic model was based on the experience of the former Soviet Union in many aspects and curbed the economic incentives of farmers and firms.

As illustrated in Fig. 6-1, during Period 1, the urban population as a proportion of China's overall population generally kept rising from just above 10% (an agrarian society), and finally reached slightly below 15%. As China's national economic order started to recover and the First Five-Year Plan was initiated, the nascent industrialization generated more job opportunities in the cities and China experienced the onset of urbanization.

1956-1978: Exploration era of the unitary public ownership and planned economy (Period 2)

The influence of the Three Reforms on the overall national economy eventually led to anxiety amongst the left over economic development, eventually resulting in the Great Leap Forward that set unachievable economic goals and used extreme means to accomplish them. During 1962-1966, however, the government did make pragmatic adjustments to economic strategies due to the economic losses incurred by the earlier policies, which lasted until the Great Cultural Revolution in May 1966. The Great Cultural Revolution, a radical and chaotic political movement, further damaged China's economy.

As suggested in Fig. 6-1, Period 2 reflected economic oscillation and a setback to China's urbanization process. The Great Leap Forward at first accelerated urbanization through poorly planned industrialization. Then, the Great Cultural Revolution and its conjoint Down to the Countryside Movement forced numerous urban citizens to move to the rural countryside, especially the youth, which exerted a strong impact on China's urbanization.

1978-1990s: Shift to a diversified economy with the predominance of the socialist public sector and a planned economy supplemented by market regulation (Period 3)

The 3rd Plenary Session of the 11th Central Committee of the Communist Party of China (CPC) in 1978 represents a turning point that initiated the Reform and Opening-Up of China. The market economy has since not been considered as the opposite to the planned economy, and China realized that only economic prosperity can gain the support of the domestic population and elevate its international status. This decision was made by objectively assessing China's productivity, learning the lessons of China's previous economic policies and drawing on foreign experience. Economic development has become the core task of China ever since, arousing enthusiasm among both farmers and firms.

Fig. 6-1 shows that during Period 3, China enjoyed a continuously ascending trend of urban population proportion, and the urban population proportion first exceeded 25% in 1987. Such impressive progress resulted from the positive influences of the Reform and Opening-Up on the national economy, which generated demand for rural labor forces as well available for urban construction.

1990s-Present: Shift to a socialist market economy (Period 4)

In order to further liberalize the economy and enhance productivity and strive for a more successful economy, the 14th National Congress of the CPC set the reform goal of establishing the system of socialist market economy in 1992. By harnessing the potential of the market, resources can be more efficiently allocated in the socialist market economy. Afterwards in 2002, the 16th National Congress of the CPC put forward that a full-fledged socialist market economy and a more energetic and open economic system should be established by 2020. In 2003, the 3rd Plenary Session of the 16th Central Committee of the CPC further formulated details on the ownership theory of a socialist market economy. Ever since, China's economy has been developing more rapidly within a socialist market framework.

In the Period 4 of Fig. 6-1, China urbanization accelerated even faster, and the urban population proportion first exceeded 50% in 2011. The broader and deeper wave of globalization is directly linked to China's transformation to a market economy. On one hand, the desire of rural population to settle down in cities and to enjoy higher-standardized lifestyles is becoming more intense, and on the other hand, the booming economy is carrying with it even more job opportunities in metropolises as well as small- and medium-sized cities, though with a series of urbanization problems emerging as mentioned in other parts of the report.

3.2.6 Development concept

Under the paradigm shifts of China's economic structure after 1949, there lie transformations in the understanding of the concept of "development" among China's leaders and its population. Since 1949, there have generally been four different understandings of the essence of "development" in China, which can be summarized as the traditional development concept, the reformative development concept, the comprehensive development concept and the scientific development concept.

The traditional development concept

The traditional development concept had long been accepted and practiced by China's leaders before 1978, which can be characterized by the focus on heavy industries for the realization of industrialization and unrealistic economic development goals. Such a concept was advocated mainly by Chairman Mao, due to the backward status of the newly founded PRC and the pressure to catch up with developed countries. The traditional development concept also borrowed greatly from the development ideology of the former Soviet Union. The Great Leap Forward is considered to be a direct result of this concept, which targeted unrealistic economic goals and turned out to be extremely harmful to China's economy.

The reformative development concept

The 3rd Plenary Session of the 11th Central Committee of the CPC in 1978 was a major turning point in the history of the New China, which introduced and initiated the Reform and Opening-Up. "To seek truth from facts" became the main ideological principal of China and hence the reformative development concept emerged. The reformative development concept is focused on the core role of economic development with reasonable goals and the emancipation and development of productive forces. This concept contributed enormously to China's economic prosperity and enhanced its international status.

The comprehensive development concept

It should be noted that during the process of the Reform and Opening Up, severe imbalances in regional development emerged across China. Hence, a revised development concept focusing more on the equity issues was needed. The comprehensive development concept also emphasized the ideology of "sustainable development." In 1995, the "the strategy of sustainable development" was discussed in the 5th Plenary Session of the 14th Central Committee of the CPC. Later in 2002, the goal of building a moderately prosperous society in all respects was established at the 16th National Congress of the CPC.

The scientific development concept

After the 16th National Congress of the CPC, the development concept has continued to evolve in China and the "Scientific Outlook on Development" was advanced in 2003. The "Scientific Outlook on Development" takes development as its essence, putting people first as its core; adopting comprehensive, balanced and sustainable development as its basic requirement; and employs a comprehensive consideration of factors as its fundamental approach. The scientific development concept inherits the merits of the previous three concepts of "development" and emphasizes the ideology of "putting people first" or "people oriented".

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ANNEXES

Annex 1 Huangshan Case Study

Annex 2 A 4-City Study of Sustainability Trends

Annex 3 4-City Database

Annex 1: Huangshan Case Study

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1 Introduction

Since 1978, China has been undergoing many transformations, including rapid economic growth, the expansion and population growth of towns and cities, the urbanization of villages and redefined political, economical and environmental international relationships. Due to the rapid economic growth since the implementation of the reform and opening up policy, China has become more urbanized. With massive city construction and rising urbanization rate over the past decades, the Chinese government is aware to focus more on a human-oriented and sustainable path. Sustainable development is a pattern of resources use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come (Brundtland Commission 1991). Therefore, three aspects have to be balanced in order to achieve sustainability, social, economic and environmental needs. Urbanization is the advanced step upon industrialization, referring to a process in which an increasing proportion of an entire population lives in cities and the suburbs of cities (Wagner, Urbanization 2008). People seek high level of social connections and economical advancement during the early stage of the process. However, environmental needs are normally ignored. Thus, the sustainability equation is not balanced. Furthermore, the sustainable urbanization development is at the stage of seeking methods to consider all aspects to achieve the sustainability.

This report consists with a case study on sustainable urbanization development in China conducted by the Project Team of Renmin University School of Environment and Natural Resources. Huangshan District, as the municipal district of Huangshan City of Anhui Province is carefully selected to be the subject of the investigation and survey. Huangshan District (referred as Huangshan) covers an area of 1,775 km^2 and is located in the northern part of the Huangshan City. It encompasses 9 townships and 5 towns, administratively, with an overall population of 162,818. Huangshan is one of the places that have the most rare natural resources and the abundant water sources among the whole nation. The Huangshan Scenic District is located in the Huangshan District with attractive tourist mountainous resource. Thus, the tourism is the central industry for the local economics and pillar industry. With the intact eco-environment and abundant natural resources, the other industries and infrastructural construction plays the supporting role to the local economic development. Therefore, the urban planning of Huangshan is mainly based on these significant factors.

2 Huangshan Urbanization's Current Situation

2.1 Society

2.1.1 Population

By the end of 2012, the total population of Huangshan district was 161,500, slightly down from 2011's 162,818.. With an area of 1775 km^2, the population density is approximately 90 people/$km^{2.}$ There were 1,452 births in 2012 with a birth rate of 0.899%, and 2,055 deaths with a mortality rate of 1.27%. The natural growth rate was -3.73%.

Fig. 2-1.1 shows the population changes in Huangshan over thirty years from 1978 to 2011. Data is based on the number of people registered in the district (based on their hukou). According to the statistics, Huangshan District's urbanization developed steadily over the past few years, from 36.4% in 2005 to 43.2% in 2011. This great increase of urbanization is largely attributed to the government-controlled residential registration status become increasingly weaker in recent years. Now that it is easier for rural residents to obtain an urban registration status, the values given for urban and rural residents are approximations since it is hard to get a definite number. The fact that the urban population was not solely comprised of the non-agricultural population indicates that a considerable number of farmers reside in town, most likely in hopes that if they find jobs in the city,

then there would be a greater chance that their applications for urban residential registration will be approved.

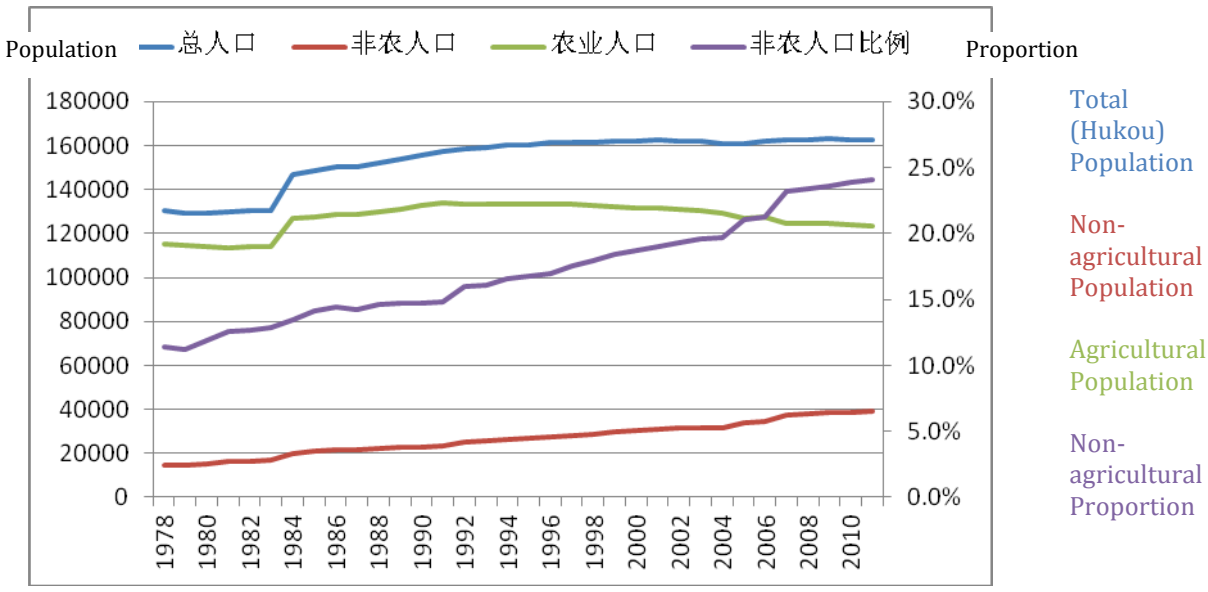


Fig. 2-1.1 Huangshan District 1978-2010 Population Structure

2.1.2 Education

When residents of Tangkou County were interviewed in 2012, they reported that in general education is not highly emphasized by the residents in the Huangshan area. As described by households that the Renmin University team surveyed, the culture in that region is one that appreciates the value of family intimacy over the material possessions. Thus many families would rather keep the family united in their hometown than send off a child and the mother to a larger city while the father stays at home to work the land. The team did of course learn of exceptions, usually wealthy families who have the ability to uproot their lives and move to places with more opportunities. By the same token, members of nearby rural villages think the same of Huangshan's education and some migrate into the area for their children's schooling.

Considering the relatively small numbers of migrants to Huangshan District, compared to the vast populations migrating to larger cities like Beijing, there are not enough immigrants for the government to create specialized schools for their children. Of the few who migrate into Huangshan, some of them do so for better academic opportunities for their children (in comparison to the poor education in their nearby rural villages) indicating that the immigrant children receive the same education as Huangshan natives.

When interviewed, many residents openly accepted their children's lack of desire to learn, allowing them to leave school and begin work if that is what they wanted. Thus, the figure 2-1.2b shows a single rising value: number of student recruits. For the rest of the values in figures 2-1.2a and 2-1.2b below, the number of educational institutions, teachers, students and graduates have all seen a decreasing trend in the years 2006-2010.

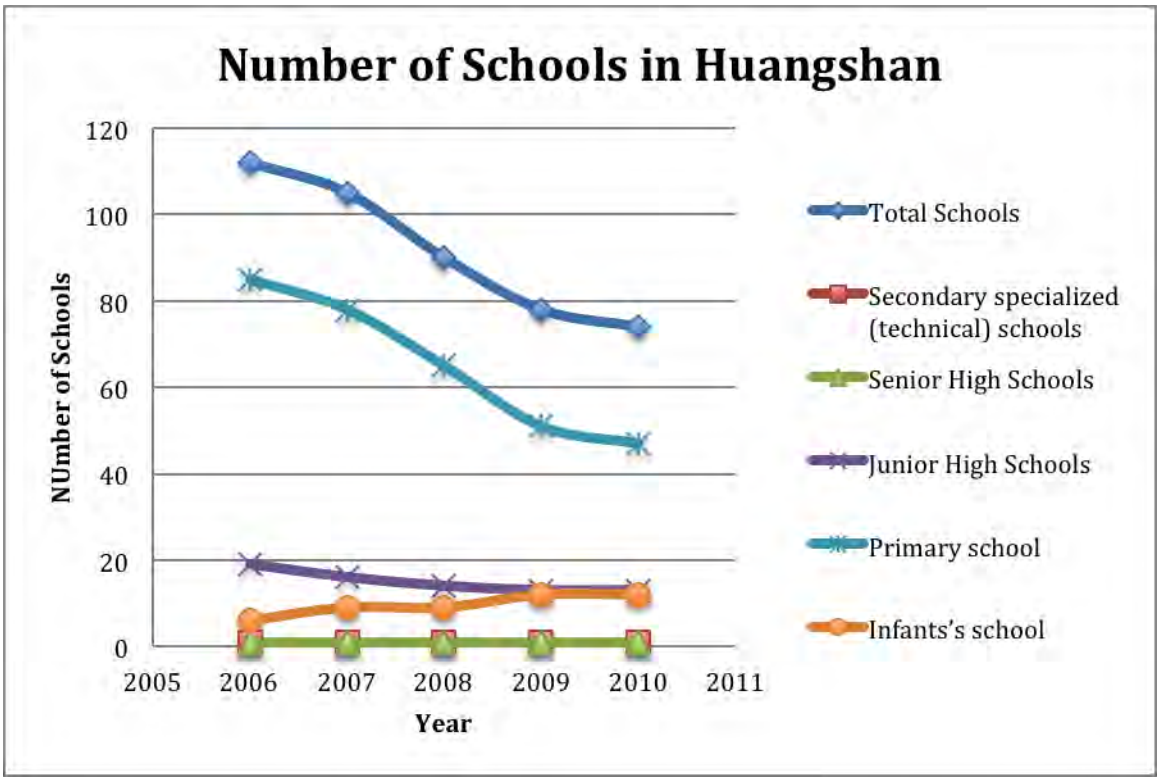


Fig. 2-1.2a Number of schools in Huangshan

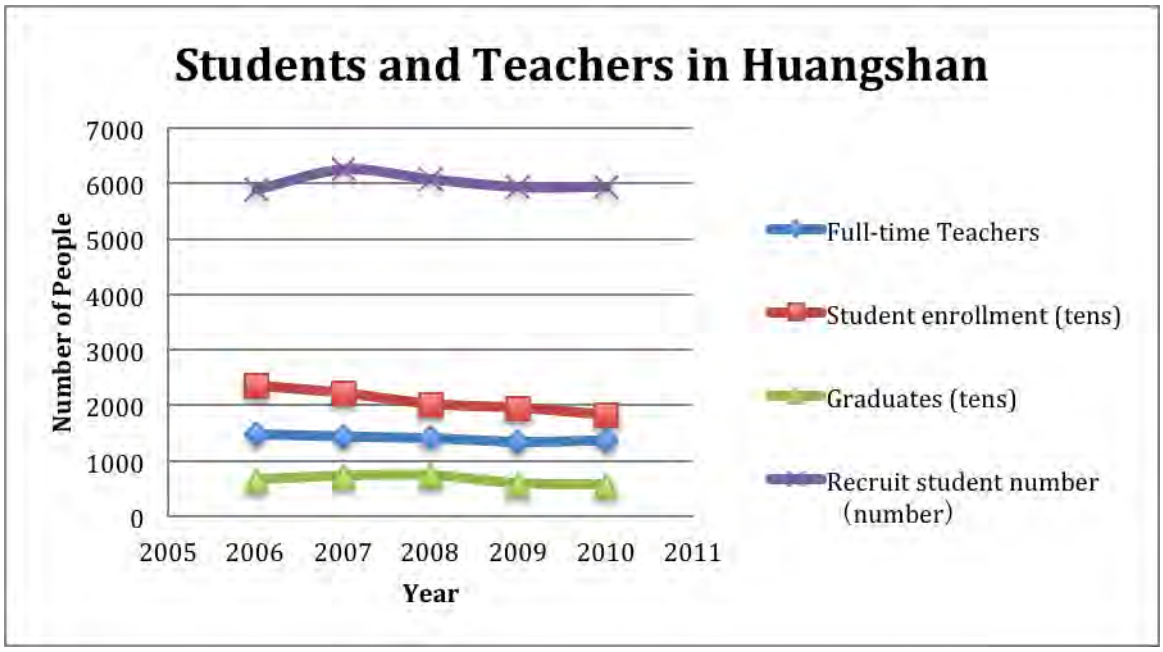


Fig. 2-1.2b Number of Students and Teachers in Huangshan (total from all educational institutions)

2.1.3 Culture

Huangshan's culture is heavily influenced by its natural resources and surrounding environment. Surrounded by one of Chin's most famous tourist-attracting mountain scenic area and producing renowned tea and bamboo items, Huangshan residents focus a lot of their lives on enriching such qualities of their city by developing family-run restaurants, operating hotels or

working at bamboo and tea industries. Thus, Huangshan creates a significant influence on the greater culture of China.

In regards to formal cultural institutions, the district has a library, a museum and a heritage management agency. As of 2010, Huangshan district lacks any performing or visual arts venues. Although this seems scarce relative to larger developed cities in China, it is not unusual for the area – the same type of situation can be found in nearby historical towns like Hongcun and Tunxi. In place of a westernized movie theater, Huangshan district contains a KTV karaoke club that provides entertainment.

As for the residents' social culture, some neighborhoods have lively night scenes, with music and dancing. Following China's general social pattern, the elderly often take their grandchildren out to walk after dinner, adding to the life of the neighborhood get-togethers. Unfortunately however, with government-issued neighborhoods or the development of new complexes, many uprooted families are unfamiliar in their new settings and thus complain about a lack of social interactions. A benefit of structured communities is the provision of representatives to oversee various aspects of living, one of which being social entertainment. With such facilities comes the organization of annual festivities and board-game type competitions.

Recreational activities aside, residents' standard of living show a cultural trend to remain focused on basic essentials rather than consumer pleasures. In the year 2010, the number of refrigerators purchased (37) was greater than all washing machines, air conditioning systems and computers added together. Televisions were the next highest electronic purchase at 23 sets, a number fairly low due to the people's habit of outdoor interactions. There was only one car sold whereas 47 total bikes, electric bikes and motorcycles were sold.

2.1.4 Health and Hygiene

As of 2010, Huangshan district had 30 health agencies,, including 3 hospitals, a center for disease control and a maternity and child care center, with a total of 495 beds. Additionally, there were 79 village-run clinics and 5 township-run health centers. Of the 650 medical personnel in the district, 150 were so called "rural doctors." Relying primarily on traditional Chinese medicine, their position as the neighborhood doctor provides both physical and financial convenience for families with minor medical problems. According to a number of elderly residents interviewed in a low-income neighborhood, they have confidence in the quality of hospitals, even though specialized medical services may not be available for their age group. At the same time, it is worthy of noting the considerably healthy quality of life that the elderly lead, with little concern about bedridden illness at age's well past-retirement.

2.1.5 Social insurance and social assistance

In the year 2010, 102 people received disability pensions (0.06% of the total population), 717 people received regular pensions (0.44% of total), 595 people received regular subsidies (0.37%), and there were 417 households under the status of preferential treatment and special comfort. In total, the amount that the government split to these individuals was 1,300,154 RMB.

In terms of minimum living standards, there were 2,429 urban residents (6.26% of the Huangshan district urban population) receiving allowances of 6,133,000 RMB in 2010. At the same time, 5,575,000 RMB of minimum living allowance was given to 6,230 rural residents (5.03% of the

district's rural population), well over two times the number of urban residents. Throughout the district, there were 15 urban community service facilities, 7 community service centers, 23 convenience networks and 3 volunteer community service organizations.

2.2 Economy

2.2.1 GDP

In 2012, Huangshan District's GDP reached 6.286 billion RMB (or $1.012 billion), an increase of 12.7% from the previous year. Per capita GDP reached 38,922 RMB (or $6,266), greater than 2011 values by 4,650 RMB.

2.2.2 Industrial structure

Of 2012's 6.286 billion RMB GDP, the primary industry in Huangshan District contributed 0.736 billion RMB, with an increase of 4.6% from 2011; the secondary industry generated 2.522 billion RMB, an increase of 14.0%; and the tertiary industry raised 3.028 billion RMB, an increase of 9.1%.

Fig. 2-2.2 depicts the changes of annual GDP and industrial structure of the district over the past 20 years. In spite of the consistent increase in GDP, the evolution of the industrial structure is more intricate. The tertiary industry proportion had been sharply rising until it reached the peak in 2002 and ever since, it has been shrinking while the secondary industry proportion keeps climbing. The conversion is possibly due to local government's secondary industry-focused development strategies relying on the abundance of local resources such as bamboo and molybdenum ore, implying the district is not satisfied solely with its developed tourism. However, this can threaten local environment and erode the sustainability of local development.

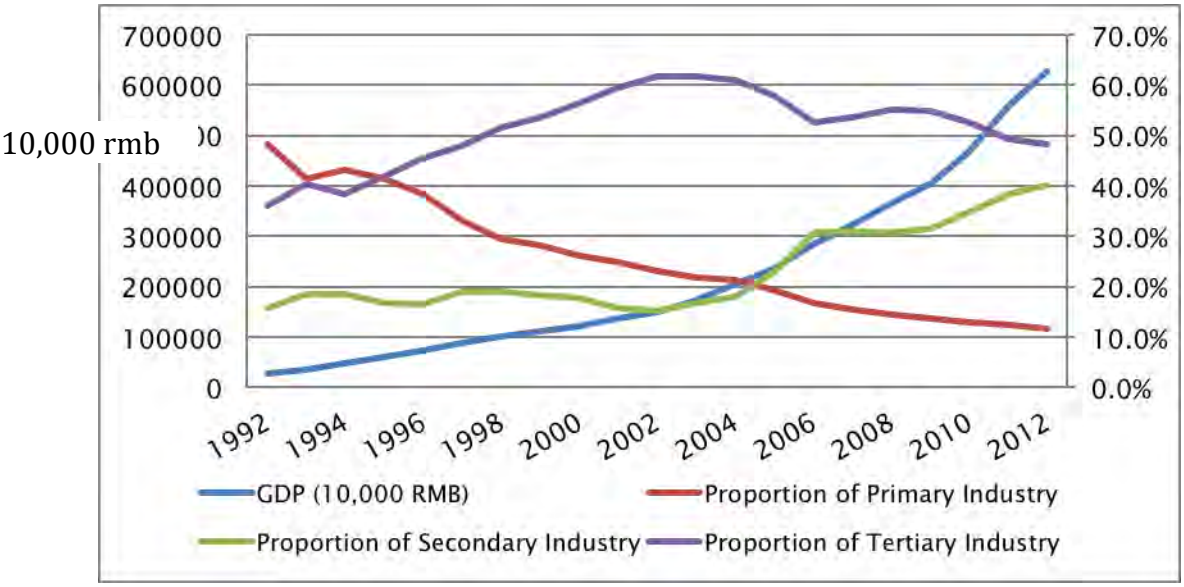


Fig. 2-2.2 The economic development data of Huangshan District (1992-2012)

2.2.3 Fiscal revenues and expenses

From 2004 to 2012, the fiscal revenue and expenses both showed trends of rapid growth, with fiscal revenue growing faster than expenditures (see Figure 2-2.3). In 2012, Huangshan District's

year-end fiscal revenue was 840,070,000 RMB, a 42.3% increase from the year before. Fiscal expense was 1,442,000,000 RMB, a 23.0% increase from the year before

In 2011, In terms of total fiscal revenue, value added tax was 155,440,000 RMB, a 13.7% increase, business tax was 186,040,000 RMB, a 40,7% increase, and income tax was 122,610,000 RMB, a 131.5% increase.

Fiscal expenditure was 1.14 billion RMB, a 37.0% increase from the year before. Of which, science and technology expenses grew 24.1%, culture, sports and media expenses grew 48.3%, health costs grew 30.8%, forestry and water services expenses grew 68.9%, and social security and employment expenses grew 30.1%.

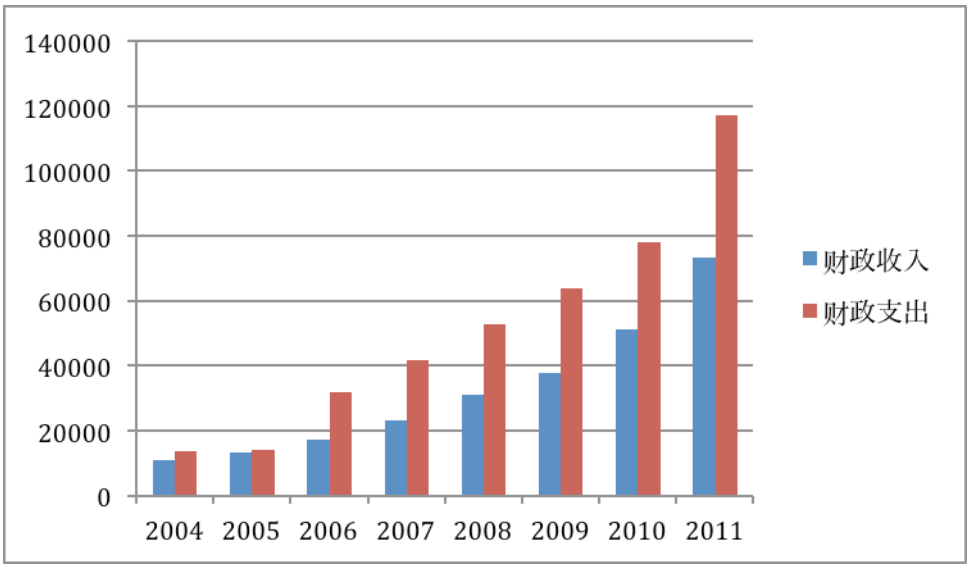


Fig. 2-2.3 A Record of Changes in Fiscal Revenue and Expenses over the years

Fiscal Revenue Fiscal Expenses

2.2.4 Labor and employment

In 2012, the entire district had 95,828 industrial employees, 2,268 people more than the year before. From 2004 to 2012, primary and secondary industries both saw an overall decreasing trend in their employment numbers whereas tertiary employment number remained stable, at a value clearly larger than the other two industries (see **Fig. Fig. 2-2.4**). Considering the rising trend of secondary industry proportion in GDP, it can be deduced that the level of automation in the district's secondary industry was elevated as well.

The year-end unemployment number of 2011 was 3,991 people, corresponding to an unemployment rate of 3.85%, which was lower than the national average of 4.1%. Hence, the district is not directly faced with a severe unemployment issue.

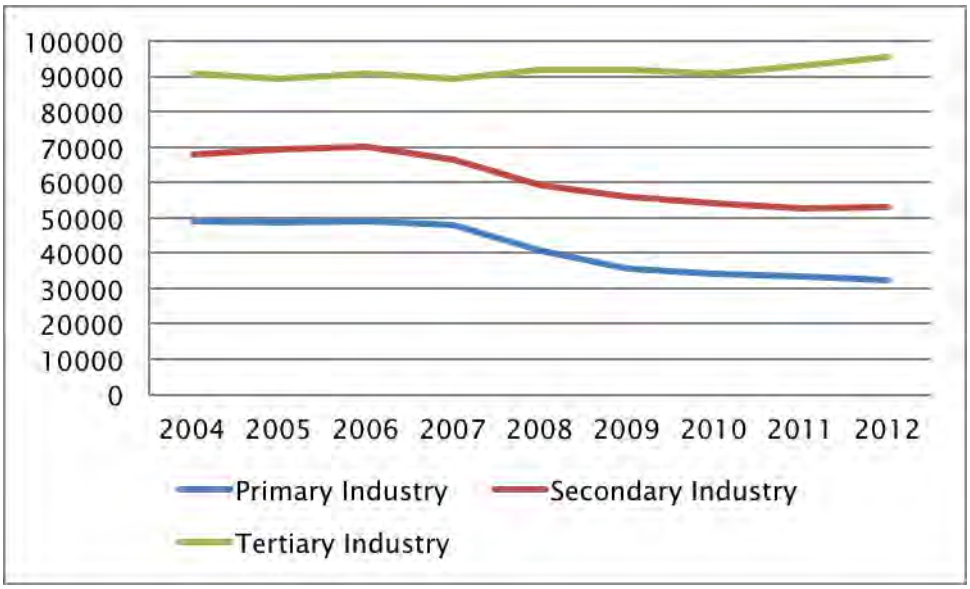


Fig. 2-2.4 The Changing Trends of the Three Industries' Employment

2.2.5 Tea and Tourism in Huangshan

Tea Industry

Huangshan is widely regarded as China's best region for tea. It has a unique environment with mild climate, abundant rainfall, an average annual temperature of 15 ℃ (59 °F) and an average annual precipitation of 1556 mm. It also has more than 200 fog days a year and the district is covered 90% by forest. Huangshan area is designated as a National Department of Agriculture famous for its green advantages of the region.

Huangshan District is the only origin and the main origin of Top Ten Famous Tea Peace Chief Monkey (Taiping Houkui) and Huangshan Maofeng. Peace Chief Monkey is regarded as the king of green tea. It won the Panama International Exposition as early as 1915. In 2007, Former President Hu Jintao as a gift gave it to Russian President Vladimir Putin. In 2010, it became the Shanghai Expo licensed product and its traditional production craft has been listed among China's national intangible cultural heritage.

Since 2000, Huangshan tea output has been rising at an increasing rate, leading to the development of the regional economy (see Figure 2-2.5a below). By 2011, the Huangshan tea output value was 304 million RMB, of which Peace Chief Monkey accounted for 79.8% and Huangshan Maofeng tea accounted for 20.2%. That year, the area of Huangshan tea production was 6.5 million mu, with a total output of 1,039 tons of tea.

In 2011 Huangshan district harvested 16.0 kilograms of tea per mu, with the average price of tea at 292 RMB/kg, the value per mu was 4672 RMB. On average, the land was split 1 mu per tea farmer. Thus, farmers in Huangshan district received a year-end income of around 5,000 RMB per capita mu whereas the origin village *of* Peace Chief Monkey has a per capita income of 200,000 RMB, ranked the first in the whole province. Other industries closely related to the promotion of the tea industry such as machinery manufacturing, agricultural production, transportation, distribution, food, cosmetics, culture and tourism have made important contributions. Continuous extension of the tea industry chain has not only expanded employment opportunities but also increased farmers' income.

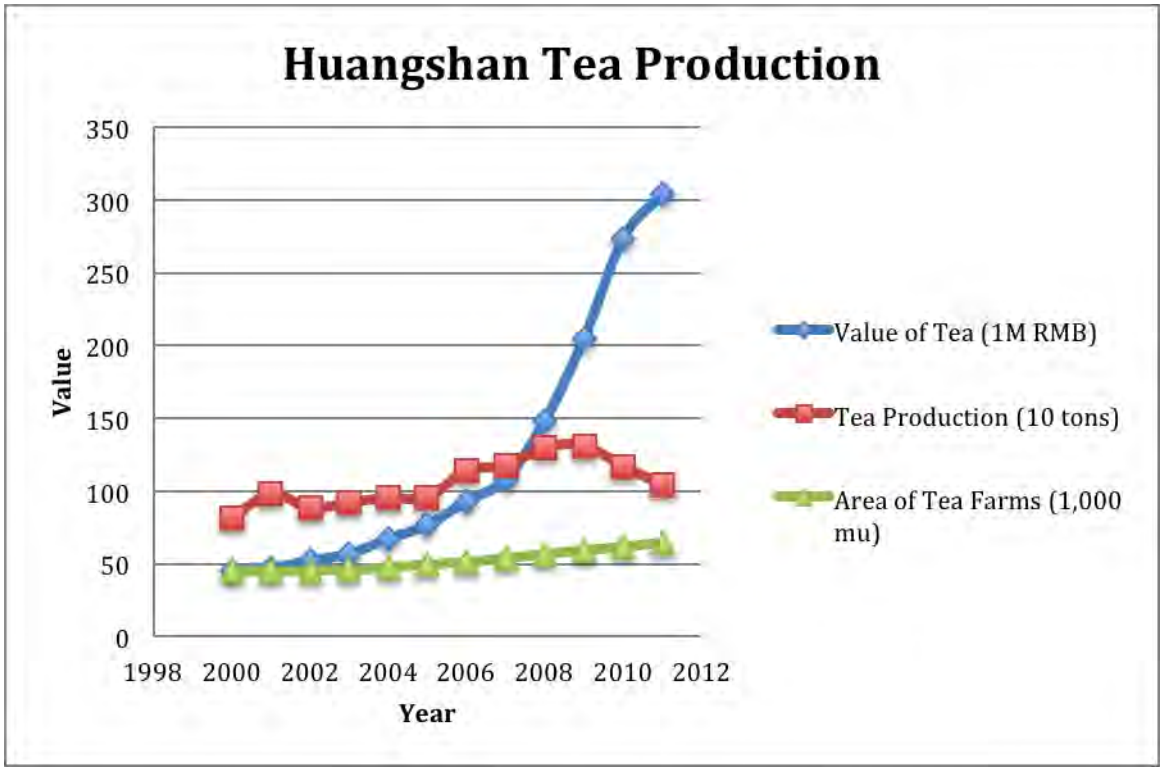


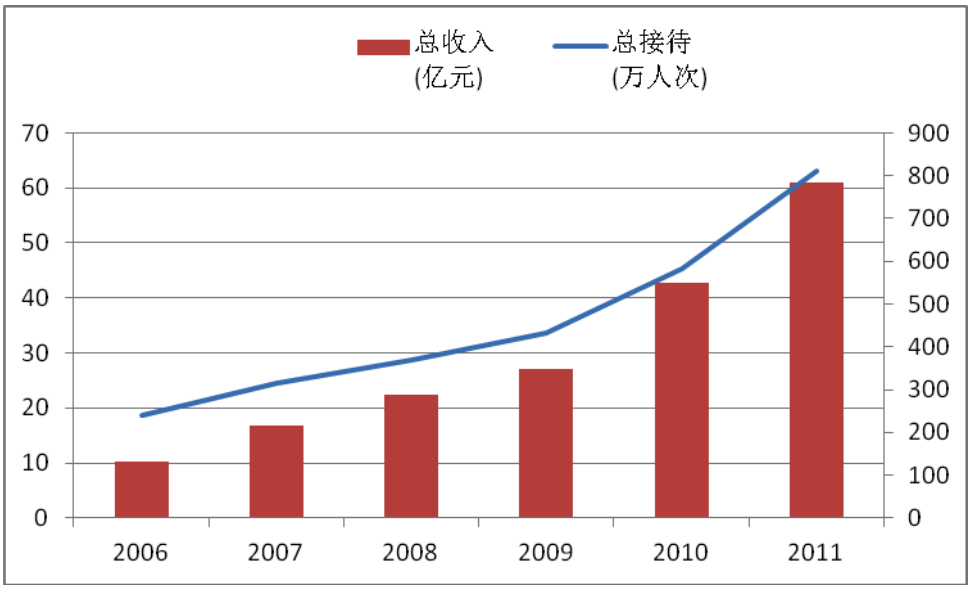
Fig. 2-2.5a Huangshan Tea Production (Value of Tea, Amount Produced, Area of Farmland)

Tourism

Huangshan City boasts one of China's most famous natural landscapes. Huangshan's natural endowment includes the spectacular Huangshan Mountains, listed as a UNESCO cultural and natural heritage and World Geopark. The area also has the Qiyun Mountain, one of the Four Sacred Taoist Mountains in China, which is ranked as a National Level Scenic Area as well as a National Geopark. In addition, the Guniujiang Nature Reserve is protected as a National Level Nature Reserve and a National Geopark. Other places of interest include the Huangshan Mysterious Grottoes, the Taiping Lake, and the picturesque landscapes along the Xin'an River.

Huangshan Scenic Area is the most popular tourist destination of all. Honored as a "National Treasure", the national park features its uniquely shaped pine trees, awesome rock formations, spectacular seas of clouds, recuperative hot springs, and fantastic winter snow scenery. As the old saying goes, "When one has visited the five mountains in central China, he will not be tempted to see any other mountains, but once he has seen the views of Huangshan, the five mountains seem attractive no longer." Apart from the extraordinary Huangshan, there are also many other places of interest and cultural relics inside the city.

Tourism in Huangshan, the number of visitors, total revenue of the industry, entry visitors and foreign exchange revenue growth rate reached 39.4%, 42.1%, 48.5% and 52.9% respectively in 2011. The Huangshan tourist accommodation and tourism revenues amounted to 8.113 million visitors and 6.089 billion RMB, 1.39 times and 1.4 times compared to the end goal of the tenth five year plan respectively. Huangshan Tourism has become an important pillar of economic development and the tertiary industry leader.



Total revenue (100 million RMB)
Total reception (10,000 people)

Fig. 2-2.5b 2006-2011 Total tourists and Income in Huangshan

2.3 Ecological environment

Huangshan District was one of the first National Ecological Demonstration, National Soil and Water Conservation Demonstration, National Forest Conservation Demonstration, and National Green Model zones. It is a city with a National Garden and a town with vast resources of natural Chinese bamboo. In March 2011, it received the national award for the best living environment and in 2012 was formally named a provincial ecological zone.

Huangshan Scenic Area's ecological environment has a beautiful view, mild climate, abundant rainfall and vegetation; the forest coverage accounts for 75.6%, with a total of 10,740.8 hectares of natural reserves in the district area, 7% of the total city's land area. The environmental quality is the best in Anhui Province.

Huanghsan's major ecological threats are related to floods and soil erosion. Floods usually happen every three to five years, causing damage to farmlands, roads and bridges. Although Haungshan is famous for its environmental and natural resource endowment, it is still facing various challenges to maintain ecological security, and the exploitation and utilization of natural resources are under control.

2.3.1 Natural resource endowments

Surrounded by an incredible natural environment, Huangshan district benefits primarily from the following resources: water, land (from which it creates its tea production), forest, and its tourism industry.

Water Resources:

Huangshan district territory is rich in natural water resources: in 2011, the volume of water within the territory was a total of 1.681 billion m^3 with 10,324.41 m^3 per capita, way beyond the national average of 1,730.20 m^3. There are 25 branches of rivers originated in Mt. Huangshan, which make the richness of both surface water and groundwater in the district. The water resource in the

district is not solely used for production and living; it also must reach downstream areas in a steady flow of freshwater quality resources.

The water resources available to Huangshan district include natural precipitation, surface water and groundwater.

1) Precipitation

Precipitation is the main source of water in Huangshan district, with 1.458 meters of rainfall in the year 2011. The district's precipitation suffers from uneven seasonal distribution - the months April to July receive about 70% of the annual rainfall. The spring season has weaker, longer lasting rain; summer sees shorter and heavier rain, with a greater chance of storms and flooding; fall is more likely to have a slight drought; and winter is a dry cold with very little rain.

2) Surface water

There are 25 branches of rivers through the district, including five main branches: MaChuan river, PuXi river, YangXi river, QingXi river and ShuXi river. Originated in Huangshan Mountain, the rivers belong in the Qingyi River upstream and flow from south to north into TaiPing Lake. The amount of water that flowed through the district's rivers in 2011 was 1.681 billion m^3.

TaiPing Lake is the largest artificial freshwater lake in AnHui province, with a maximum depth of 70 meters and an average depth of 40 meters. According to Huangshan district's three hydrological stations' historical statistics, the highest water level ever measured was at 128 meters, with a corresponding storage capacity of 2.92 billion m^3. The lowest water level was 98 meters, at a storage capacity of 430 million m^3.

3) Groundwater

In Huangshan district, there are many cracks that help to recharge groundwater from the rivers' runoff; the river basin largely is all hidden underground. Currently, use of groundwater is not common in Huangshan district. In 2011, the district's total groundwater resource was 230 million m^3.

Land Resources:

According to the 2010 survey data of land use change in Huangshan District (shown in figure 2-3.1a), the total land area is 174,699.34 hectares (or 174.7 million m^2)., in which rural land is 158,447.6 hectares, 90.7% of the total land; land used for construction is 11,059.89 hectares, 6.33% of the total land; and total other land area is 5,191.85 hectares, 2.98% of the total land. This situation is coherent with the rustic status of the district. However, considering the mentioned fiscal constraint, it would be irrational for the district to practice a more radical urbanization path.

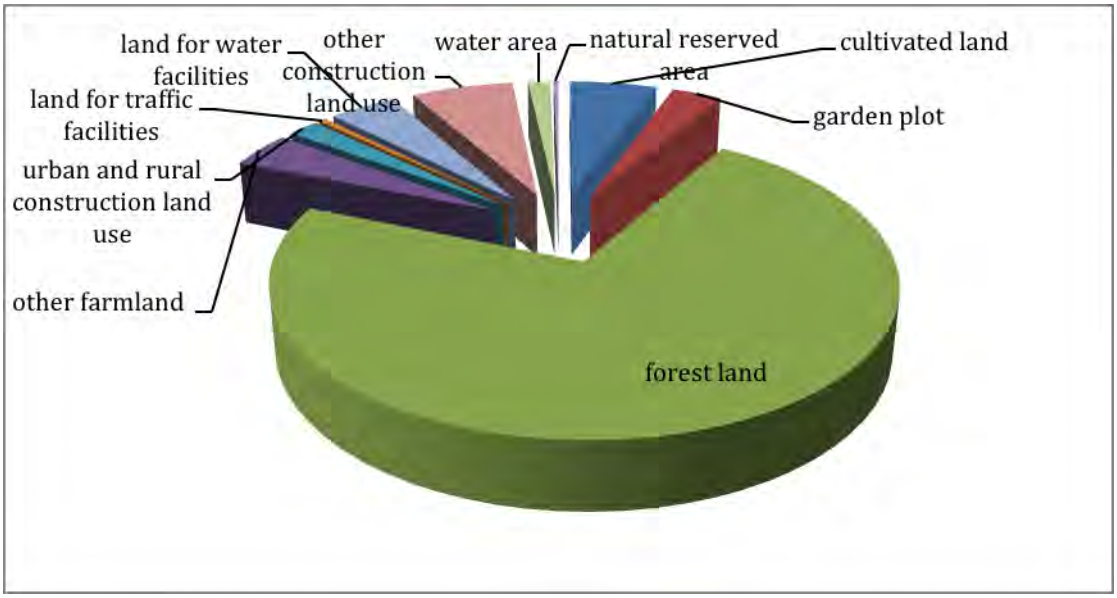


Figure 2-3.1a The current situation of land use in Huangshan district

1) Rural Land

At the end of 2011, the agricultural area was 10,753.37 hectares in Huangshan district, 6.79% of total the rural area; the garden plot area was 5,302.17 hectares, 3.35% of total farmland area; the forest land was 139,737.34 hectares, 88.2% of total farmland area; and other farmland total area was 2,654.72 hectares, 1.68% of total farmland area.

2) Construction Land

At the end of 2011, the urban and rural construction land in Huangshan district was 4,505.46 hectares, accounting for 40.74% of total construction land area; the roads and water conservancy land use was 1,381.74 hectares, 12.5% of total construction area; and other construction land use area was 5,172.69 hectares, 46.76% of total construction area.

3) Other Land

At the end of 2011, Huangshan district's water area was 4,186.86 hectares and the nature reserve land was 1,005 hectares.

Biological Resources:

1) Forest resources

Huangshan district has an excellent ecological environment. Huangshan district was the first in the entire country to be determined a state-level Ecological Demonstration Area and Soil and Water Conservation Demonstration Area. Huangshan district's natural vegetation is primarily subtropical evergreen broad-leaved vegetation; it is the main zone for forests of that tree species in southern Anhui Province, and entire stretch of vegetation. There is a wide variety of natural vegetation but having been under human influences for a long time, original vegetation has barely survived; now, most vegetation is either secondary or artificial.

There exists a fairly obvious vertical zonation of vegetation: from sea level to 500 meters is largely artificial cultivation, comprised of human-planted trees, deciduous evergreen broadleaf forest and shrub forest; at the altitude of 500-1000 meters, the evergreen forest consists of sclerophylla, eyrei, white oak, small-leaved white oak, etc., with more deciduous trees throughout, creating the full deciduous evergreen broad-leaved forest; at the altitude of 1000-1400 meters, there is a more complex species of deciduous broad-leaved forest, mostly calyx-lacking maple,

Chinese scholartree, fragrant fruit trees, and Maoli trees; at an altitude of 1400 meters and above, oak trees dominate Huangshan's deciduous evergreen forests and mountain shrubbery, with pine trees distributed above 700 meters. By the end of 2011, the woodland area was 128,533 hectares, the amount of ground that had become woodland throughout the year was 1271 hectares, the amount of trees cut down amounted to an area of 6.84 million m^2, forest area was 118133 hectares and the forest coverage rate was 75.6%. The forest coverage rate for the larger Taiping Lake Scenic district is higher than 95%, as displayed below in figure 2-3.1b.

Fig. 2-3.1b The Vegetation Coverage of Huangshan district

2) Wild plants

Within Huangshan district, there is a vast amount of wild plant resources. There are 128 families and over 900 species of commonly seen wood-based plants. The main types of evergreen broadleaves are oriental white oak, sclerophylla, stone oak, purple nan, Chinese photinia, eyrei, and Chinese ilex; the main types of deciduous broadleaves are saw tooth oak, maple, cork oak, noisy leaved poplar, yellow sassafras, Chinese scholartree, Chinese pistache, elm and cedar, etc.; the main types of conifers are fir, pine, Huangshan pine and juniper; the main types of rare and precious trees are larch, tri-tipped fir, southern yew, East Douglas fir, southern Chinese hemlock, thorned Chinese catalpa, money willow, Indian bay-tree, and wingceltis, etc, of which the southern yew is a national Grade A protected plant and fragrant fruit trees are a national Grade B protected plant; in terms of bamboos, there are furred bamboo, henon bamboo, golden bamboo, round bamboo, bitter bamboo, water bamboo, indocalamus, purple bamboo, rohan bamboo and snow bamboo.

3) Wild animals

In Huangshan district, the main types of wild birds are pheasant, red-billed Leiothrix, yellow-waist warbler, yellow-billed egret, red-headed diving duck and more than 170 other species, of which black deer, clouded leopard and pheasants are considered national Grade A protected animals and macaques, stump-tailed macaques, pangolins, and civets are considered national Grade B protected animals. Every year there are about 20,000 egrets and nearly 10,000 ducks and geese that populate the habitat, with up to 40,000 wintering waterfowl; the main types of mammals are deer, macaques, stump-tailed macaques, black deer, pangolins, large Indian civets, masked civets and 80 more species; the main types of reptiles are turtle, tortoise, acutobin, cobra, green bamboo snake, golden krait, silver krait, garter snakes, Chinese water snakes and 40 more species. The main types of amphibians are salamander, black-spotted frogs, spinosa, toads, Chinese marsh frogs, newts and 20

more species. Additionally, there are a variety of insects including bees, butterflies, dragonflies, crickets, mantis and cicada, etc.

4) Agricultural species

Agricultural crops mainly include grain, oil, cotton, vegetables, fruit, medicine, hemp, mulberry and other miscellaneous products that add up to a total of over 400 planted goods. Rice is the staple food crop, followed by wheat and beans; cash crops are mainly sesame, peanut, watermelon, sugar cane, cotton, hemp and tobacco, etc. The bulk of Huangshan district's livestock are cattle and pigs, of which there are native breeds, introduced species and hybrids. Huangshan area is one of the three largest bamboo production bases in the province. Of China's 10 big tea brands, "Chief Piece Monkey" and Huangshan Maofeng are native to Huangshan; and the rich Chinese torreya, dried mushrooms, fruits, vegetables, rice paper and over 50 types of native crops are in line with green standard products.

Mineral Resources:

Huangshan district's mineral resources include gold, molybdenum ore, Huangshan jade, coal, granite, limestone and clay.

2.3.2 Air quality and pollution emissions

In 2011, Huangshan's urban air had averaged monthly sulfur dioxide (SO2) concentrations within the 0.009~0.023 mg/m^3 range, with the yearly average at 0.015 mg/m^3; monthly nitrogen dioxide (NO2) concentrations averaged within the 0.008~0.032 mg/m^3 range and the yearly average at 0.017 mg/m^3; and the monthly average of PM_{10} was within a range of 0.023~0.072 mg/m^3, averaging to 0.044 mg/m^3 for the full year. The urban sulfur dioxide, nitrogen dioxide and PM_{10}'s yearly average concentration, according to Environmental Air Quality Standards (GB3095-1996 and amendments), were within the Grade B standard concentration limits; of those values, sulfur dioxide and nitrogen dioxide's average concentrations reached Environmental Air Quality Standards (GB3095-1996 and amendments) Grade A standard concentration limits; thus making particulate matter Huangshan district's environmental primary pollutant.

In 2011 SO2 and NO2 variations became more consistent: January through March saw relatively higher concentrations that stabilized in succeeding months. PM_{10} (from January to March and October to December) had rising concentrations, while the remaining months of the year it was basically stable. With the urban environmental air quality's primary pollutant being particular matter and dust, the type of air pollution is developing from soot pollution to a combination of soot and vehicle exhaust pollution.

Huangshan district's urban air pollution was on average less than 100 (Grade B Air Quality Standard) the entire year; with 252 days of the year having air pollution values of less than or equal to 50 (Grade A Air Quality Standard), the number of days with excellent air quality was 69% of the year. The year's TSP daily average reached Grade A, with annual average dust being 8 tons/km^2, not exceeding the phenomenon. Industrial sites in various industrial companies all updated their smoke and dust facilities, reaching exhaust emissions standards. With the amount of transit motor vehicles in Huangshanincreasing, there is definitely pollution of automobile exhaust emissions for the cities Tangkou, Xianyuan, Tanjiaqiao, Sankou and other towns along the major roads.

In May 2012, Huangshan district's Environmental Protection Agency upgraded their automatic air monitoring stations from "Anhui Province's Air Monitoring Network" to the "National Air Monitoring Network", and started daily monitoring of $PM_{2.5}$.

In addition, atmospheric environmental issues caused by the wet deposition of its air has become an important quality in Huangshan district's environmental indicators.

2.3.3 Water quality and pollution emissions

Water Quality of Taiping Lake:

Taiping Lake, as a deep water lake, in Huangshan District is the largest fresh water man-made lake in Anhui Province, and situated between Yellow Mountains and Jiuhua Mountain. It extends 48 km from east to west and covers an area of about 100 km^2.

Currently, Taiping Lake's water quality is basically stable in three categories. According to the 2008-2011 Taiping Lake Database on water quality monitoring (as seen in figures 2-3.3a, 2-3.3b and 2-3.3c), Taiping Lake water remained at Class 3 standards. In the three years, COD_{Mn} average reached the water quality standards' Class 2 standard (maximum of 4 mg/L); the TN concentration in some months was slightly below Class 3 standards (at a limit of 0.5 mg/L); the lake water's TP concentration for the most part averaged Class 2 standards (below 0.025 mg/L), with individual months worse than the Class 2 standard.

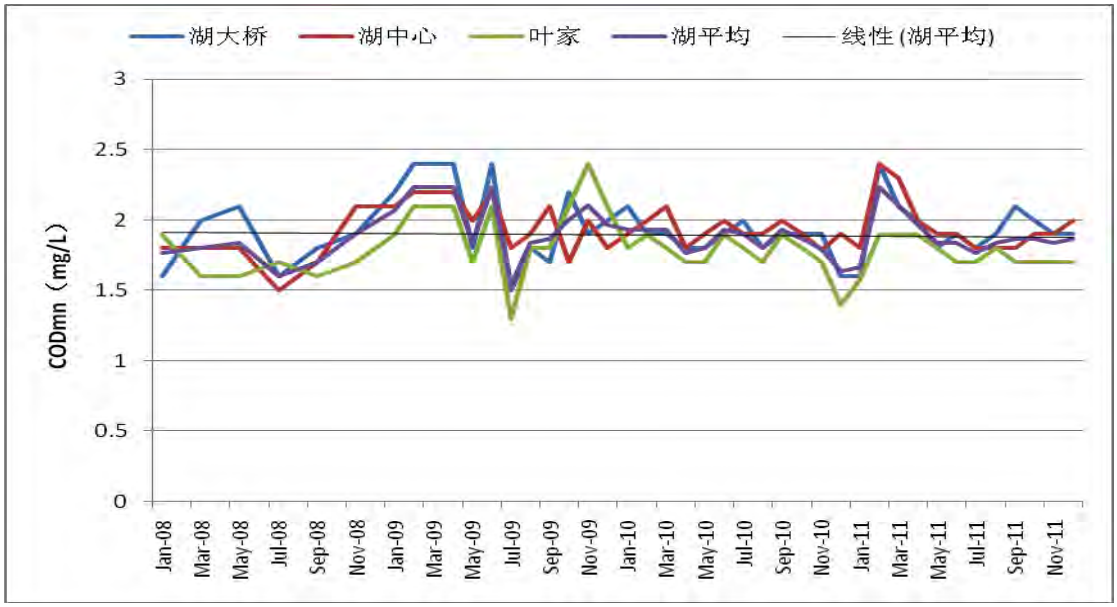


Fig. 2-3.3a Taiping Lake District's Water Quality Monitoring Results (COD_{Mn})

Lake Bridge Lake Center Yejia Lake Average Lake Linear Average

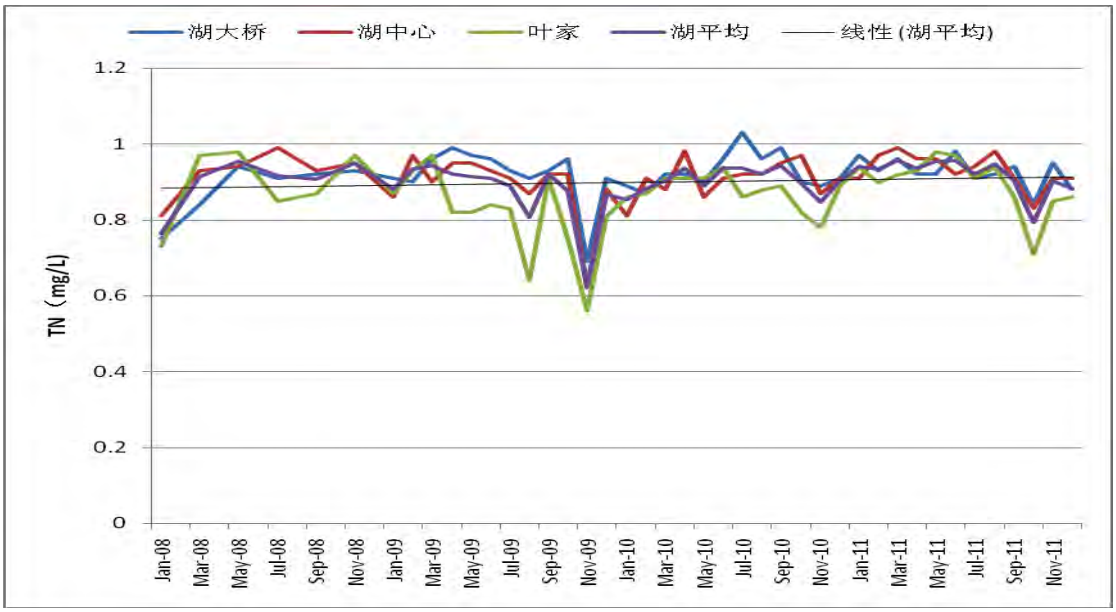


Fig. 2-3.3b Taiping Lake District's Water Quality Monitoring Results (TN)

Lake Bridge Lake Center Yejia Lake Average Lake Linear Average

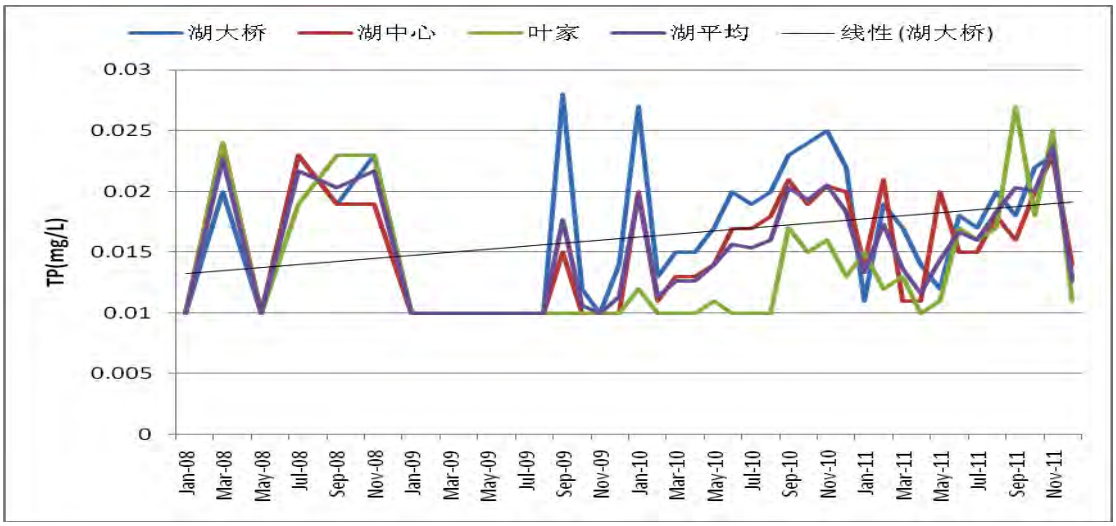


Fig. 2-3.3c Taiping Lake District's Water Quality Monitoring Results (TP)

Lake Bridge Lake Center Yejia Lake Average Lake Linear Average

According to the 2003-2011 monitors for different lakes' degree of eutrophication evaluation, Taiping Lake in recent years has a eutrophication level between 20-50 composite index TLIc, indicating that the lake is overall in the "oligotrophic-mesotrophic" level. Taiping Lake's water quality in 2011 was fairly good. The overall rating was in the "mesotrophic" level, with eutrophication at 30.8, a 3.9% increase from 2010. The functionality of water is evaluated as Class 3 by the national Surface Water Quality Standards (GB3838-2002).

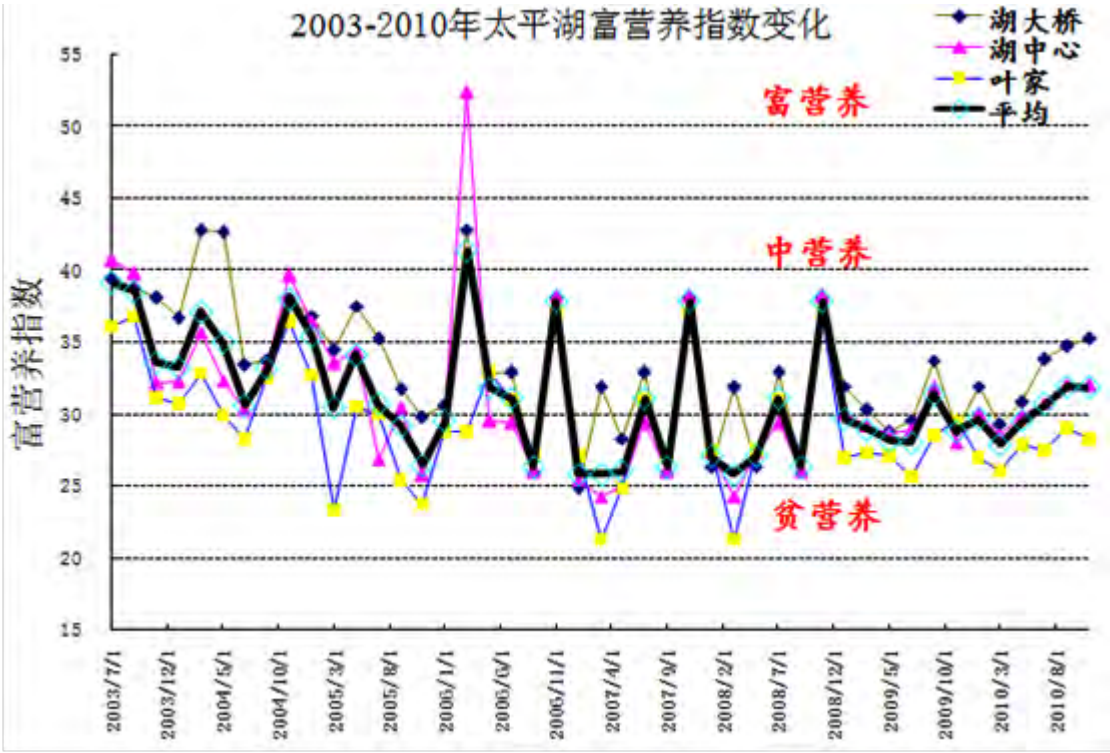


Fig. 2-3.3d 2003-2010 Taiping Lake's Change in Eutrophication Index

Lake Bridge Lake Center Yejia Lake Average

Rich Eutrophication at 55, Medium Eutrophication at 40 and Low Eutrophication below 25

Water Quality of Major Rivers Flowing into Taiping Lake:

According to water quality database between January 2010 and November 2011 on the five major rivers flowing into Taiping Lake, Yangxi river, Shuxi river and Qingxi river have relatively better water quality, with average TP levels at 0.1 mg/L and below, reaching a Class 2 surface water standard (0.1 mg/L), and with ammonia levels below 0.1 mg/L, attaining a Class 1 stanard (0.15 mg/L). TN levels fluctuated between 0.5~1.2 mg/L. Puxi river and Machuan river have relatively worse water quality, with TP remaining at Class 3, though there were some months when it surpassed Class 3 standards (0.2 mg/L), usually occurring between August and October every year. More than once, ammonia concentration grew close to Class 3 standards (1.0 mg/L). TN concentrations fluctuated between 1 mg/L~2mg/L, equivalent to lake water quality standards of Class 3 to Class 5, causing most of Taiping Lake's water pollution.

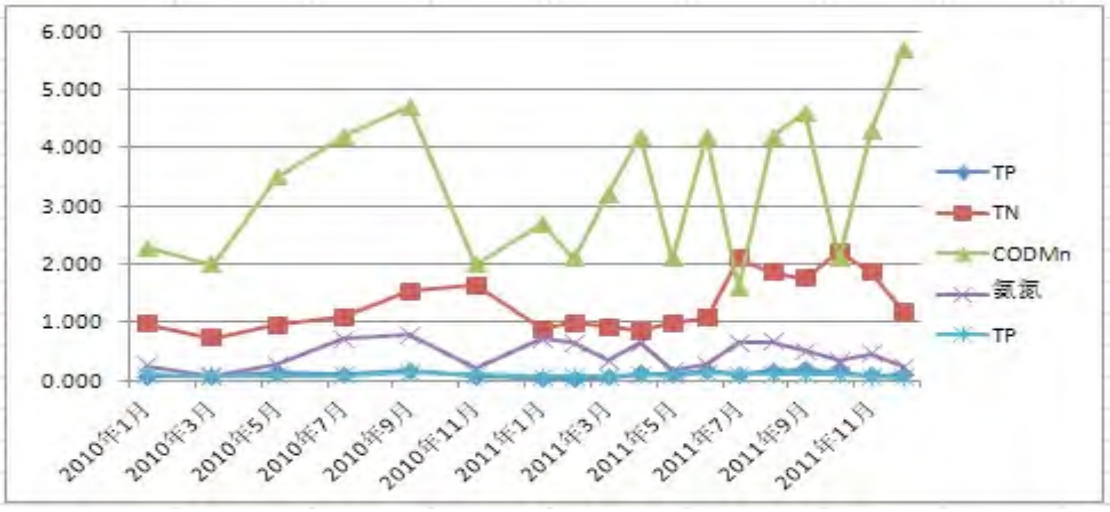


Fig. 2-3.3e Puxi River's Rocky Section

TP TN COD_{Mn} Ammonia

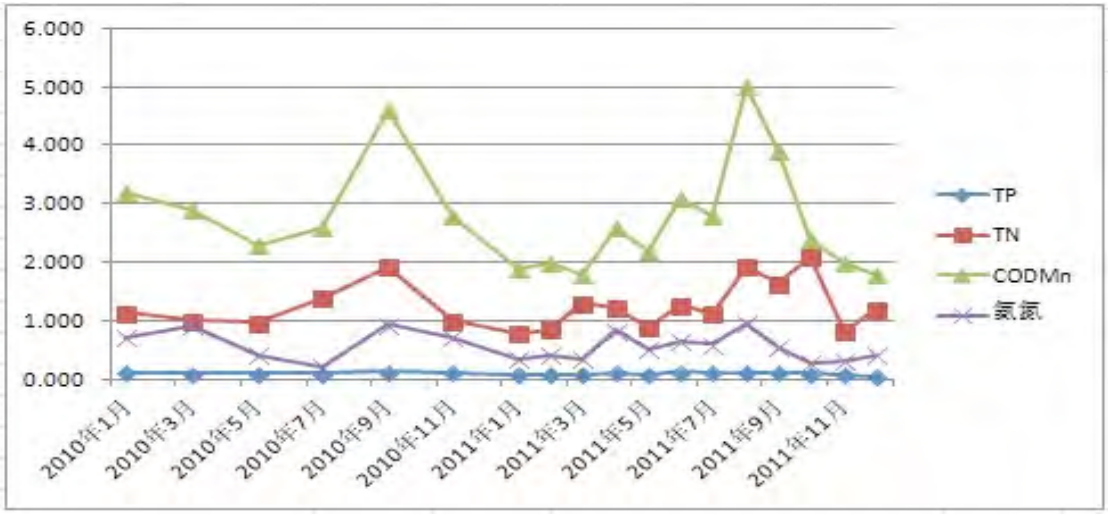


Fig. 2-3.3f Machuan River's Section near Xianyuan Village

TP TN COD_{Mn} Ammonia

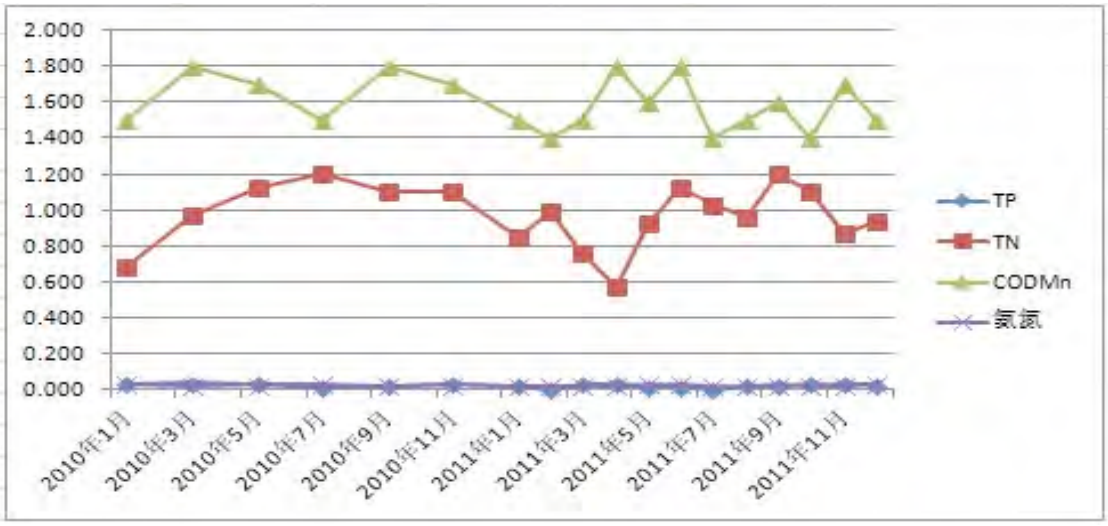


Fig. 2-3.3g Yangxi River's Section near Wangcun

TP TN COD_{Mn} Ammonia

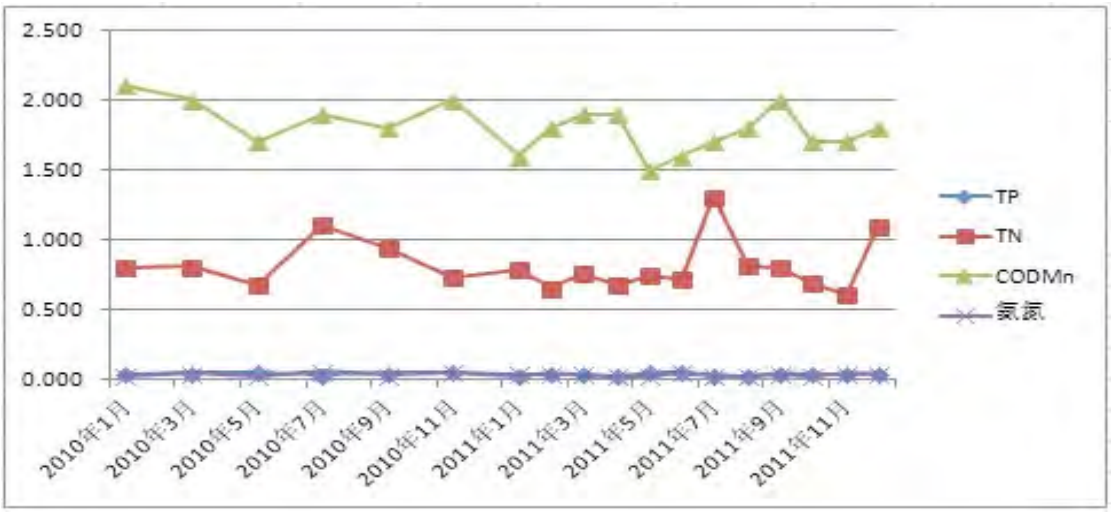


Fig. 2-3.3h Shuxi River's Section near Hejia

TP TN COD_{Mn} Ammonia

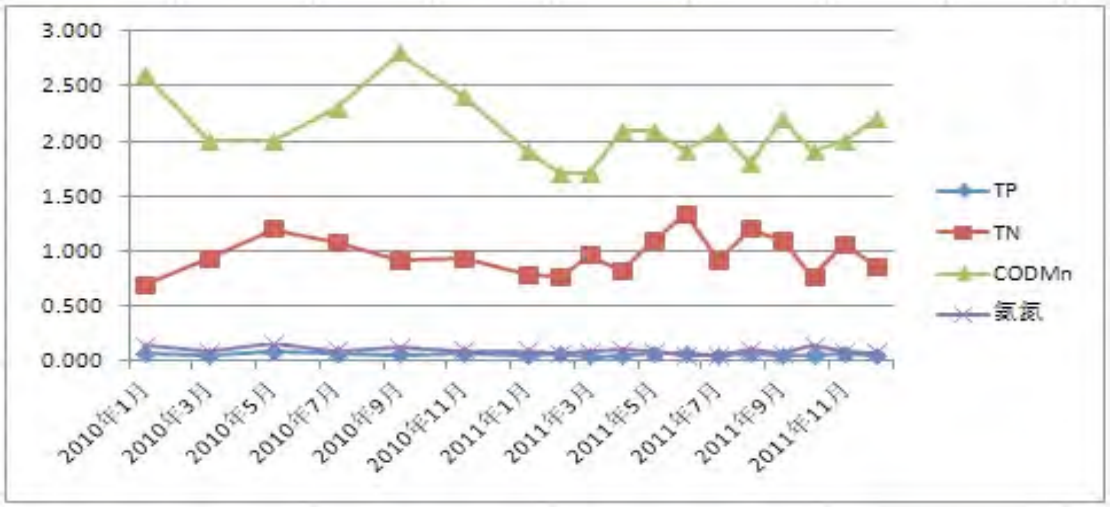


Fig. 2-3.3j Qingxi River's Section near Wushi Village

TP TN COD_{Mn} Ammonia

Water Quality of the Source of Drinking Water:

In 2011, Huangshan District had a total of 11 monitoring stations for its urban and rural centralized drinking water sources, all of which used surface water as a water source. The urban water source's water quality was monitored once a month – 12 times a year. The monitoring had 28 categories: water temperature, pH, total phosphorous, potassium permanganate index, dissolved oxygen, fluoride, volatile phenol, petroleum, fecal coliform, ammonia, sulfate, total nitrogen, BOD, chloride, iron, manganese, nitrate, copper, zinc, selenium, arsenic, cadmium, hexavalent chromium, lead, mercury, anionic detergents, cyanides and sulfides. The rural water quality was monitored seasonally – 4 times a year. That monitor contained 10 categories: water temperature, pH, dissolved oxygen, permanganate index, fluoride, ammonia nitrogen, total phosphorus, fecal coliform, volatile phenols and oil.

In 2011, the urban water source quality was fairly good, reaching Grade B protection levels for its water quality requirements; according to Surface Water Quality Standards (GB3838-2002) of three levels of evaluation, the urban water source quality had a compliance rate of 100% all year. The rural 10 categories for surface water quality became steady, with excellent water quality,

reaching Grade A protection levels for its water quality requirements; with the three classes of Surface Water Quality Standards (GB3838-2002), it reached Class 2, with a compliance rate of 100% all year.

2.3.4 Solid waste generation and emissions

The source of solid waste in Huangshan district is primarily from industrial, agricultural and residential production. The territory's yearly production of molybdenum tailings is around 5,000 tons, which ends up in a tailings storehouse; the production of molybdenum is currently being stopped. Industrial sites send solid waste to disposal concentration settings, then ultimately the waste goes to a landfill. From agricultural production, the use of agricultural film as well as chemical fertilizers and pesticides become a major source of solid waste. Most towns' residential households' waste is collected centrally and then transported to the district's landfill for processing. Taiping lake, with its scattered villages around it, has branches of the lake that contain small amounts of floating garbage due to mismanagement. In addition, Huangshan scenic area's catering and other services' solid waste create a negative impact on the ecological environment.

2.3.5 Sound Quality of the Environment

Huangshan district's traffic on the main road in 2011 had an average daytime sound level within the 67.0~73.1 decibel range, with some sections of the road exceeding 70 decibels, and overall noise compliance rate at 72.4%.

In 2011, Huangshan's urban district's environmental noise level remained at a functional-area noise standard, with excellent overall sound quality, the urban environment's noise source primarily coming from traffic and social living noises. The average daytime regional sound environment remained within the range 46.6~62.8 decibels. Within that, residential and educational areas had an average daytime sound environment within the range 46.6~53.7 decibels; commercially and industrially mixed areas were between 47.3~59.2 decibels; and fully industrial areas had average daytime noise levels of 49.2~58.1 decibels.

i. Environmental pollution emission treatment

1) Pollutant Emissions

Atmospheric pollutant emissions:

In terms of atmospheric pollutants, Huangshan district's main source is industrial emissions. In evaluating Huangshan recent years' industrial atmospheric pollutant emissions (figure 2-3.6a), industrial emissions, sulfur dioxide emissions, dust and soot emissions and NOx emissions all increased at first and then recently decreased.

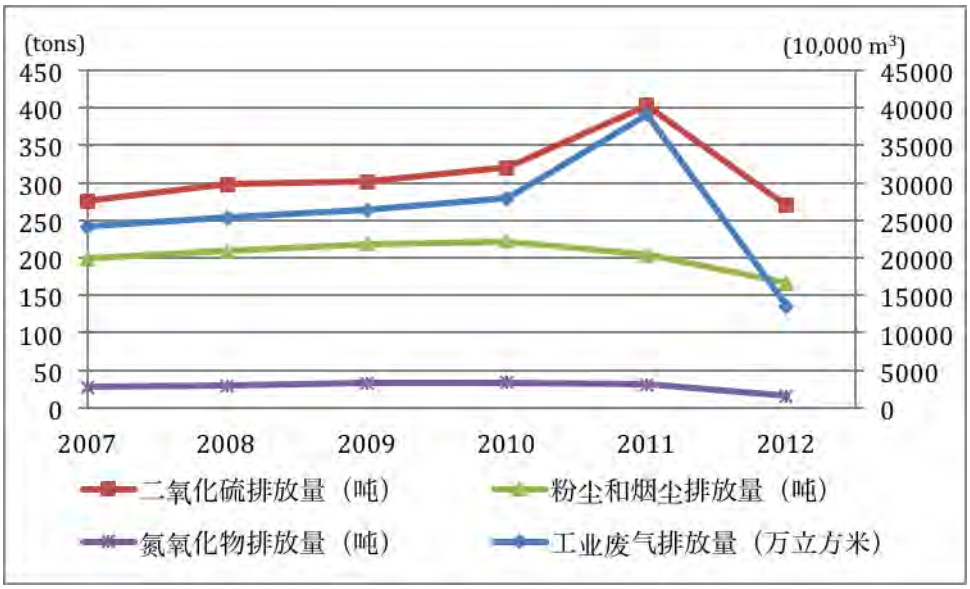


Fig. 2-3.6a Huangshan District's Industrial Atmospheric Pollutant Emissions

Sulfur Dioxide Emissions (tons) Dust and Soot Emissions (tons)

NOx Emissions (tons) Industrial Emissions (10,000 m^3)

Water pollutant emissions:

The main sources of water pollutant emissions for Huangshan district are industrial wastewater emissions, residential polluted water emissions and agricultural and livestock wastewater emissions. From recent years' evaluation of Huangshan district's industrial wastewater emissions (figure 2-3.6b), industrial wastewater emissions and COD emissions both first rose and then fell, whereas ammonia emissions gradually decreased and oil emissions basically stayed at more or less 0.65 tons. Huangshan's recent years' emissions of agricultural and livestock wastewater is in the image below (figure 2-3.6c).

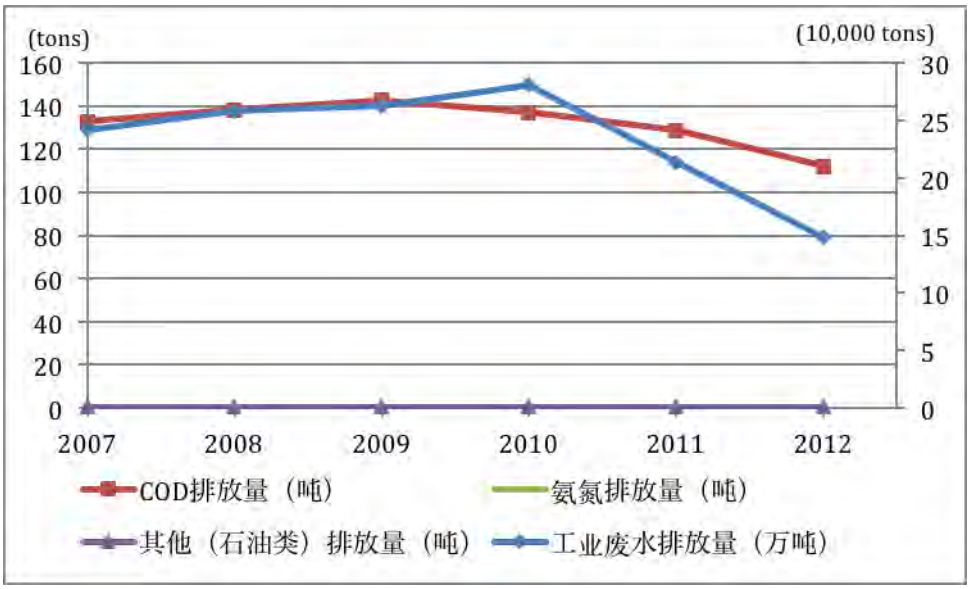


Fig. 2-3.6b Huangshan District's Industrial Wastewater Pollutant Emissions

COD Emissions (tons) Ammonia Emissions (tons)

Other (i.e. oil) Emissions (tons) Industrial Wastewater Emissions (10,000 tons)

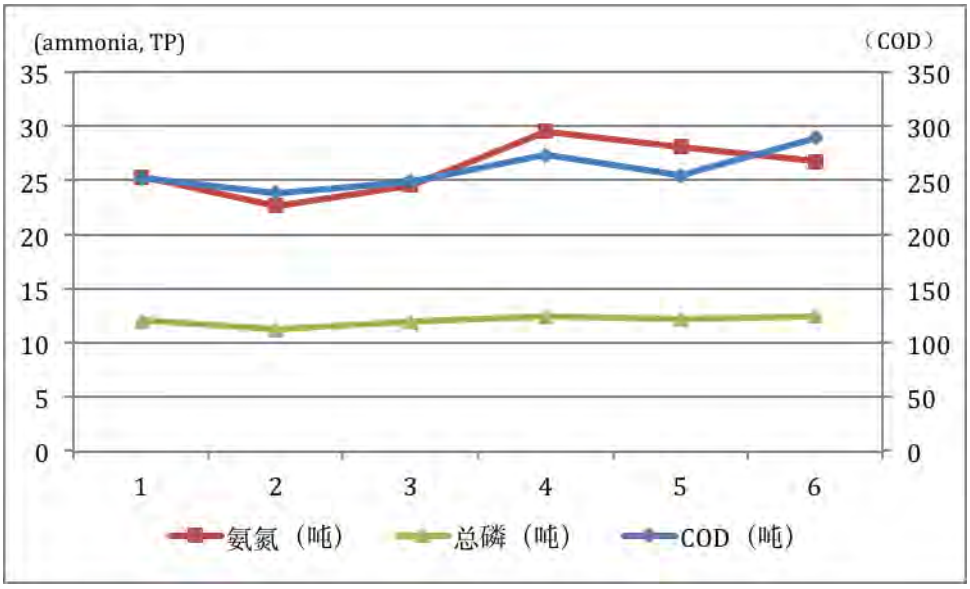


Fig. 2-3.6c Huangshan District's Agricultural and Livestock Wastewater Emissions

Ammonia (tons) TP (tons) COD (tons)

Solid waste emissions:

The attained data is primarily based on industrial solid waste emissions. From recent years' evaluation of Huangshan industrial solid waste emissions (figure 2-3.6d), the amount of industrial solid waste produced is basically maintained at more or less 3,800 tons and the amount of industrial solid waste utilized is maintained at more or less 3,500 tons.

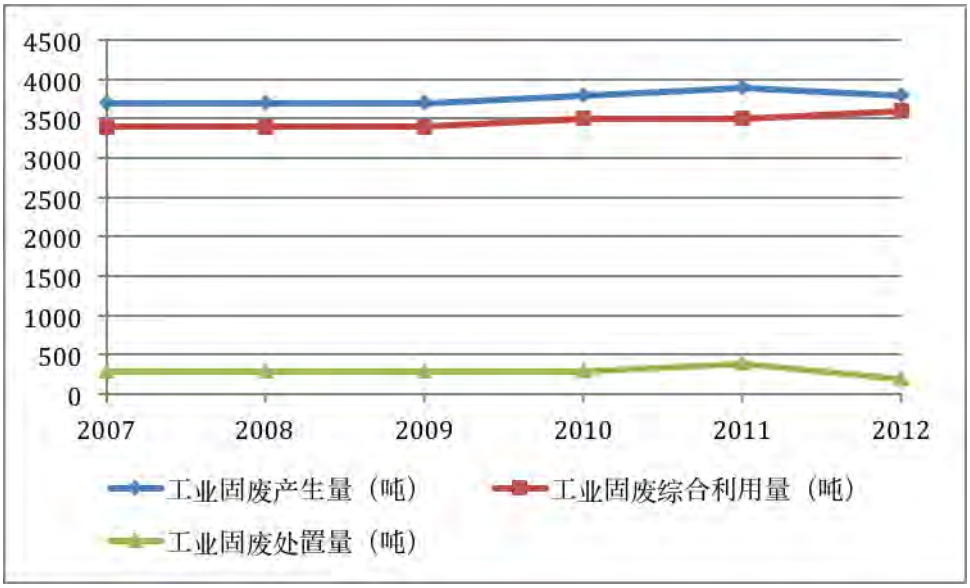


Fig. 2-3.6d Huangshan District's Industrial Solid Waste Emissions

Industrial Solid Waste Produced (tons) Industrial Solid Waste Utilized (tons)

Industrial Solid Waste Disposal Capacity (tons)

2) Handling of Pollutants

Treatment of industrial atmospheric waste pollutants

In evaluating Huangshan's recent years' treatment of industrial atmospheric waste pollutants, the overall situation is fairly good: in terms of soot and dust removal, it's been maintained at over 1300 tons, with a decline in the past two years; in terms of sulfur dioxide and NOx removal, the early years of 0 treatment has increased in the past two years, indicating that Huangshan district has placed greater emphasis on control of industrial atmospheric waste pollutants.

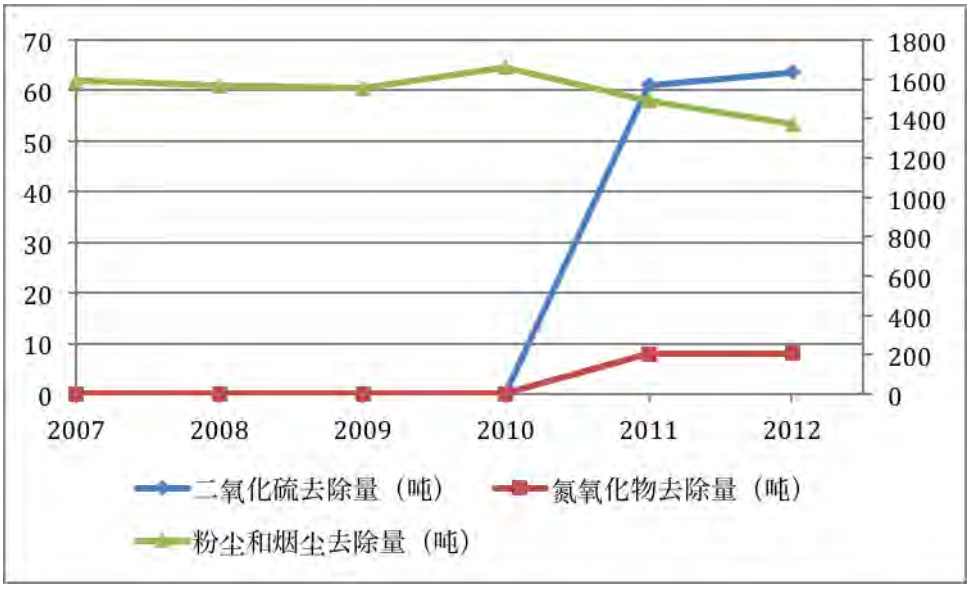


Fig. 2-3.6e Huangshan District's Industrial Atmospheric Waste Pollutant Treatment

Sulfur Dioxide Removal (tons) NOx Removal (tons)

Soot and Dust Removal (tons)

Treatment of industrial wastewater pollutants

In recent years, Huangshan's industrial wastewater pollutant treatment evaluation shows an ever-increasing trend of wastewater treatment capacity, from 1200 tons in 2007 to 2015 tons in 2010, and maintained at 2015 for the past three years, with a wastewater compliance rate remained at 100%.

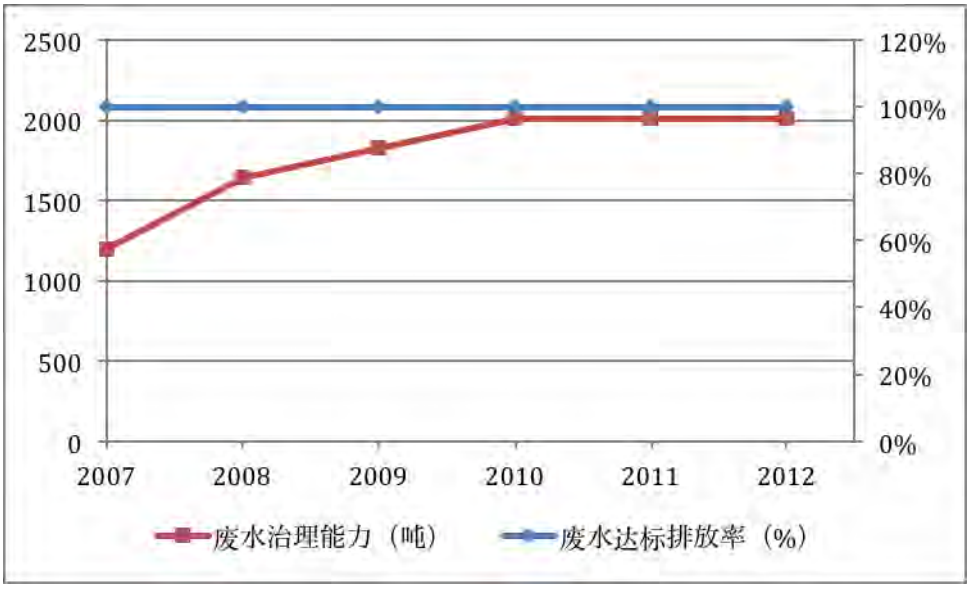


Fig. 2-3.6f Huangshan District's Wastewater Pollutant Treatment

Wastewater Treatment Capacity (tons) Wastewater Compliance Rate (%)

Sewage treatment plant's treatment of residential sewage

In recent years, Huangshan's sewage treatment plant's treatment of residential sewage shows that accumulated treatment and the operating load rate are increasing nonstop: from 256,000 m^3 and 56.89% respectively in November 2008 to 482,900 m^3 and 103.85% in May of 2013. In looking at the primary pollutant reductions, COD, TN and TP reductions do not follow a solid pattern, most likely due to their monthly difference in concentration in and out of water.

Fig. 2-3.6g Huangshan District's Wastewater Treatment Plant

Accumulated Treatment Amount (10,000 m^3) Operating Load Rate (%)

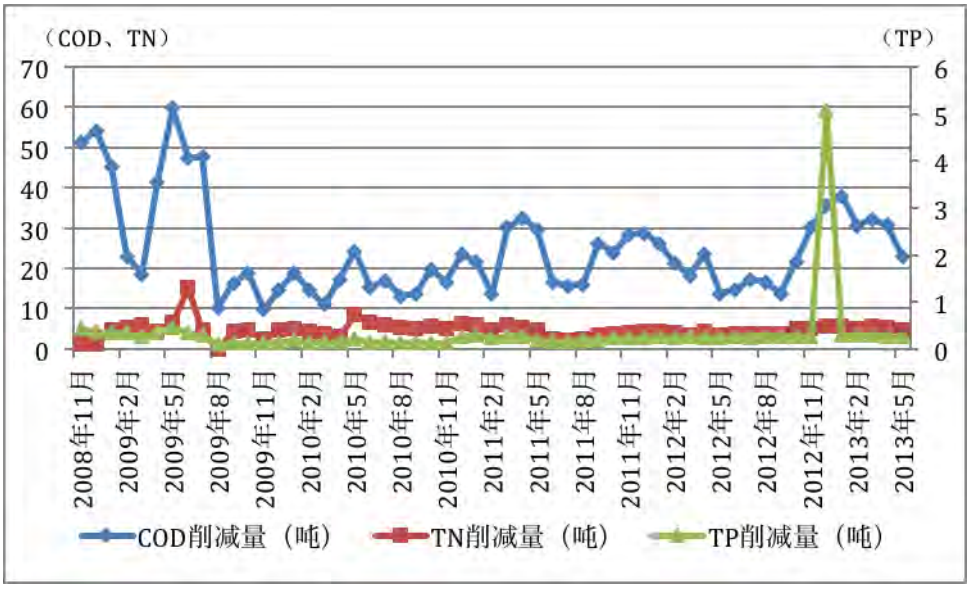


Fig. 2-3.6h Huangshan District's Wastewater Treatment Plant's Primary Pollutant Reductions

COD Reductions (tons) TN Reductions (tons) TP Reductions (tons)

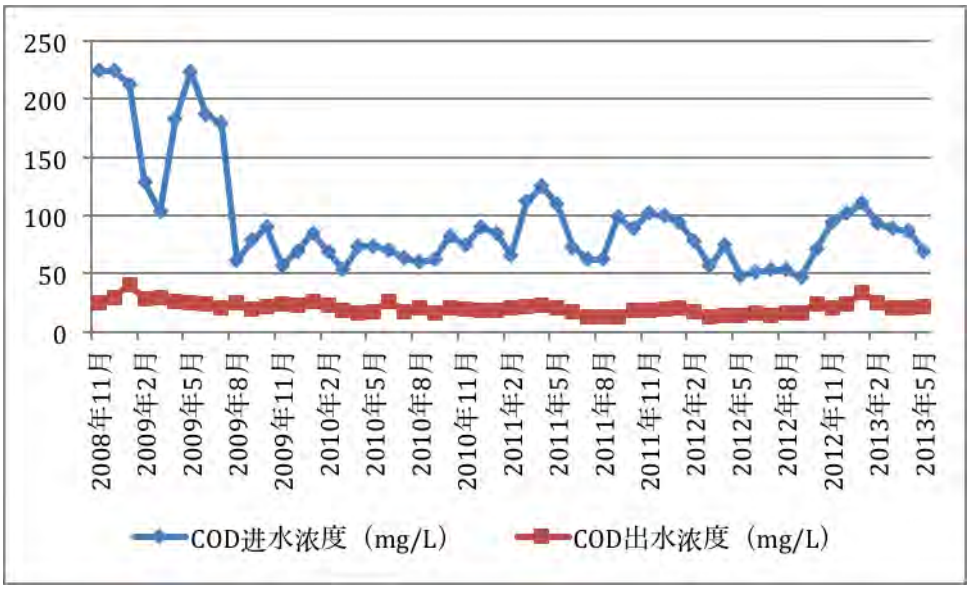


Fig. 2-3.6j Huangshan District's Wastewater Treatment Plant's COD Concentration

COD Concentrations in water (mg/L) COD Concentrations out of water (mg/L)

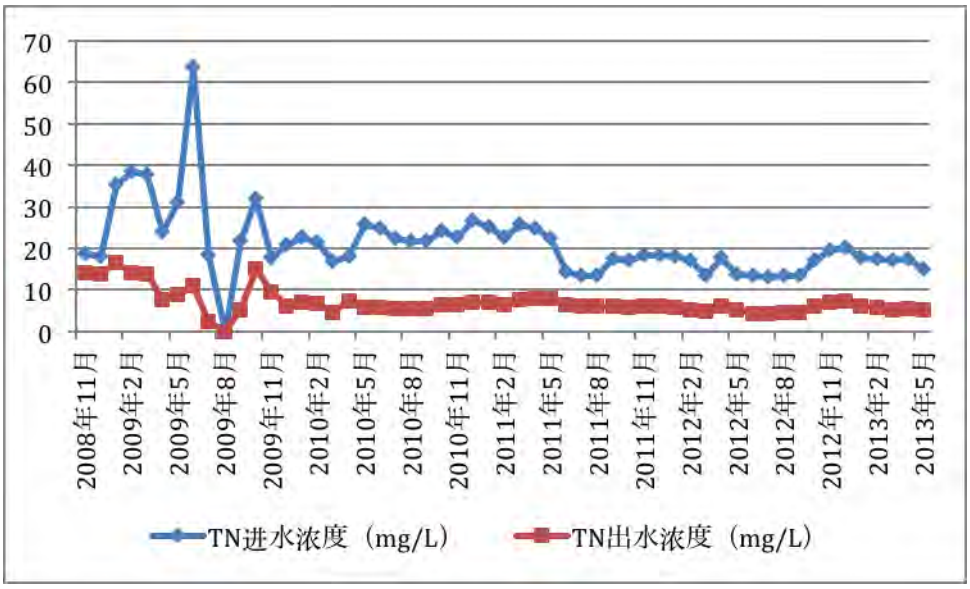


Fig. 2-3.6k Huangshan District's Wastewater Treatment Plant's TN Concentrations

TN Concentrations in water (mg/L) TN Concentrations out of water (mg/L)

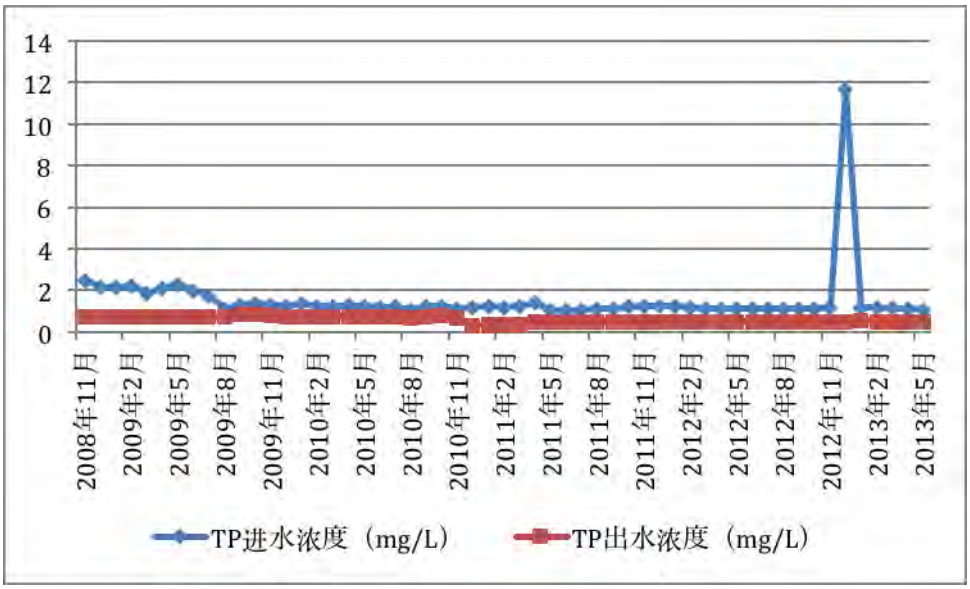


Fig. 2-3.6m Huangshan District's Wastewater Treatment Plant's TP Concentrations

TP Concentrations in water (mg/L) TP Concentrations out of water (mg/L)

2.3.6 Environmental Protection Investment and Income

Currently, Huangshan's environmental protection investment is mainly in the form of industrial atmospheric waste treatment facilities, industrial atmospheric waste treatment investment, and industrial wastewater treatment facilities. According to the figure below, industrial atmospheric waste treatment investment and industrial wastewater treatment facilities' costs have an overall rising trend; industrial atmospheric waste treatment facilities in 2007 required 215,000 RMB which rose to 275,000 RMB in 2010, after which decreased in the following two years, to 168,000 RMB by 2012.

In evaluating the past few years' environmental protection expenditure, the amount has seen an overall increase, though the fiscal budget's expenses on environmental protection rose from 2% in 2006 to 4.9% in 2008 and then deceased again to 2.7% by 2011. In recent years, Huangshan district's environmental protection bureau's sewage charge collection has seen an overall increasing trend, with only slight decreases from the year before in 2008 and 2012; from 2009 to 2010 there was a great increase, from 370,740 RMB to 700,000 RMB.

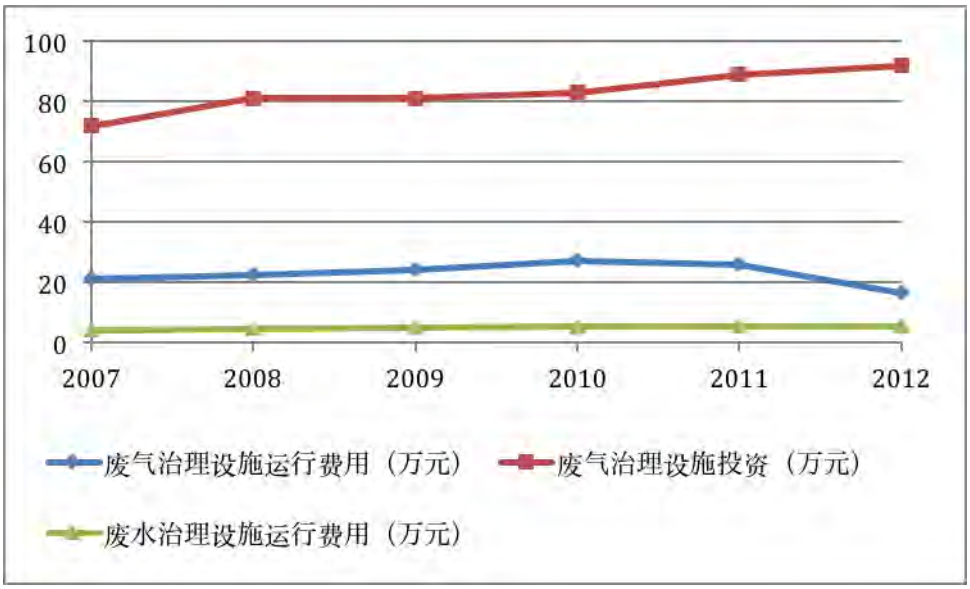


Fig. 2-3.6n Huangshan District's Industrial Environmental Protection Investment

Cost of Running Atmospheric Waste Treatment Facilities (10,000 RMB)

Atmospheric Waste Treatment Investment (10,000 RMB)

Cost of Running Wastewater Treatment Facilities (10,000)

Fig. 2-3.6p Huangshan District's Environmental Protection Expenditure

Environmental Protection Expenditure (10,000 RMB)

Environmental Protection Expenditure as a Proportion of the Fiscal Budget Expenses (%)

Fig. 2-3.6q Huangshan District's Environmental Protection Bureau Wastewater Collection Fees (10,000 RMB)

2.4 Energy systems

2.4.1 Fossil Fuel Energy and Renewable Energy

Fossil Fuel Energy

Huangshan district lacks natural fossil fuel energy resources, without any oil and natural gas resources and only a small amount of coal deposits – reserves worth about 201,600 tons.[66] However, because the mining sites are scattered, the extraction method is difficult and mining accidents often occur. For these reasons, the sites were shut down in 1992. Currently, the coal used in the district is imported from outside the city, often even from outside the province.

Sinopec, PetroChina, and public refueling points are the primary providers of refined oil. In the district, there are a total of seven Sinopec gas stations, two PetroChina gas stations, fourteen public refueling points and eight community gas stations. Sinopec and PetroChina gas stations supply most of the refined oil; the public refueling points are dispersed around the rural area, used mostly by farmers for agriculture, living and transportation energy demands.[67]

In terms of liquefied petroleum gas (LPG) and natural gas, LPG is supplied two ways: via inter-district company supply and the purchase of supply from outside by individual residents, the former only having one company supplying deep drilling LPG, set up in 1992 and restructured in 2002 to become a private enterprise. LPG is mostly supplied by canister, with some LPG supplied by pipeline. Currently the supply is 1,200 tons to three neighborhoods, with five kilometers of pipeline and twelve gas supply websites. In terms of canister sales, the price currently is approximately 103 RMB.[68]

[66] Source: Qiong Qu's Master's Thesis
[67] Source: Interview with Huangshan district's Business Bureau
[68] Source: Deep Source Gas Companies

Similar to LPG, Huangshan district's natural gas supply started rather late. Currently, the district is mostly dependent on the Hong Kong – China natural gas agreement for its supply and started construction of the natural gas pipeline network in 2009 and started receiving supply in 2011. By 2012, the length of the pipes was 21,045 meters, supplied to forty-three households and two individuals. Natural gas' sales price differentiates between residential use and business use; the purchase price is 3.56 RMB/m^3, the sales price is either 2.45 or 4.25 RMB/m^3, and the amount purchased for residential, business and industrial use is about 1,670, 12,040 and 3,655,300 m^3 respectively. The development of natural gas has dramatically changed the market for liquefied petroleum gas in the district in addition to affecting other sales.[69]

Renewable Energy

In terms of renewable energy, Huangshan district is rich in water resources, with water reserves reaching 60,000 kilowatts and an additional 48,000 kilowatts of potential development. The district's hydropower resources have developed fairly quickly. Currently, there are already five rivers in the district on which thirty stations of hydropower have been constructed, supplying a volume of 31,820 kilowatts in 2012 and generating capacity of nearly 77 million kilowatt hours, a difference of 1.4 and 3 times the respective values of 2006.[70] In the foreseeable future, Huangshan district's hydro energy resources have space to develop. However, the potential ecological threats of hydropower exploitation should be taken into consideration by the local authority and hence a careful cost-benefit assessment is in required for new hydropower projects.

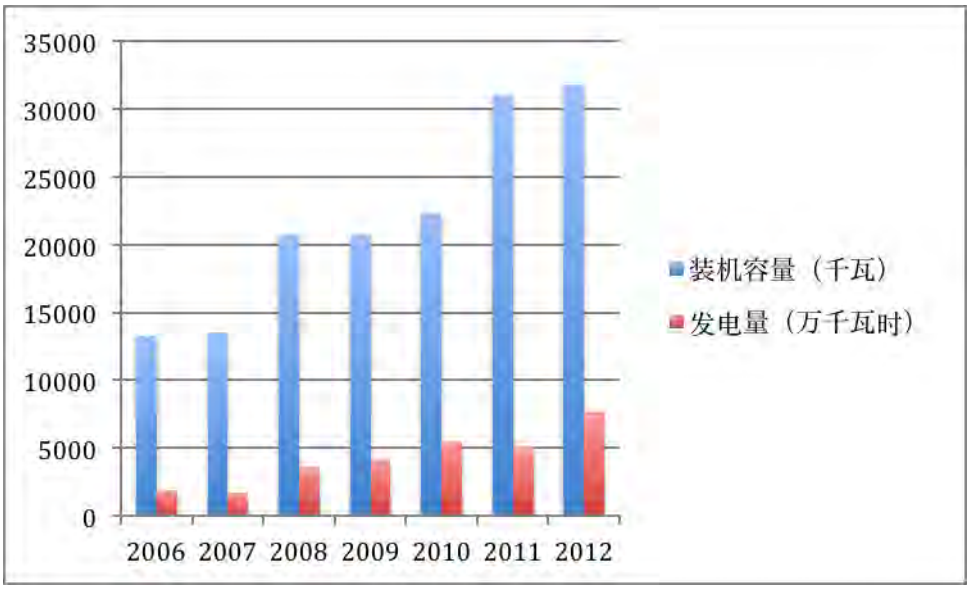


Fig. 2-4.1 Huangshan District's hydropower stations' capacity and power generation (2006-2012)

Installed Capacity (kilowatts) Generating Capacity (10,000 kwh)

In terms of agricultural bioenergy, the district's crop pattern is based on rice and oil distribution; the resources could theoretically reach 70,000 tons, the equivalent of 33,000 tons of coal.[71] With the agricultural biomass' high mechanization rate, however, stalks are still basically

[69] Source: Provided by Hong Kong – China Gas Companies
[70] Source: Provided by Interviews with the Water Conservancy Bureau
[71] Souce: Qiong Qu's Master's Thesis

entirely used for planting; therefore, currently there are no projects of using stalks for energy. With the support of the national and local government, the district has created programs of using livestock manure for biogas supply, which has been provided to 6,000 people and 40 mid-sized farms.[72] The use of biogas by residents creates a significant construction and management problem: the follow-up management investment of both manpower and finances is not enough – farmers' management and protection awareness remains fairly poor – therefore the operational effects of investments are not efficient.

In regards to the development of forestry biomass energy, Huangshan district is rich in resources, with a forestry coverage rate of 75.8%. In 2012, the area of forest covered 1.93 million acres, taking up 78.3% of land area. Forestry biomass has a theoretical potential of 78,000 tons of coal equivalent.[73] However, the district's use of forestry energy is currently very low.

In terms of solar energy use, Huangshan district is rich in solar resources. In the thirty years between 1971 and 2000, the yearly average of sunlight was 1,648 hours, making it a "very rich" resource.[74] As for making use of the rich sunlight resources, the district's residents often use solar panels to heat their water.

Use of renewable energy in Huangshan district for energy production and consumption is proportionally very low. The main forms of renewable energy include hydropower, biogas, and solar heating of water supply, of which hydropower development has been relatively abundant with future development plans already determined and 66% of available hydro energy resources already being used. Development plans for biogas have also already been made to provide for 6,000 homes and 40 mid-sized farms; the main problem, however, is poor post-maintenance and in reality, the operational rate is not high. Solar energy use for heating water is fairly common and has achieved widespread acceptance.

2.4.2 Energy Consumption

a. Overview of Energy Consumption

Huangshan district's energy consumption has grown fairly quickly, with 201,300 tons of coal equivalent consumed in 2012, twice the amount consumed in 2005. Under the eleventh five-year plan, yearly average energy consumption growth reached 7.9%, a higher value than the country-wide average growth value of 6.6%.[75] The value for 2012 was greater than 2011 by 8.1%.

[72] Source: Provided by the Agricultural Committee Energy Office

[73] Source: Qiong Qu's Master's Thesis

[74] Source: Ibid. The country's determination of sunlight abundance is split in the following categories: extremely rich, very rich, rich or ordinary.

[75] Source: http://jingji.cntv.cn/20110311/104499.shtml

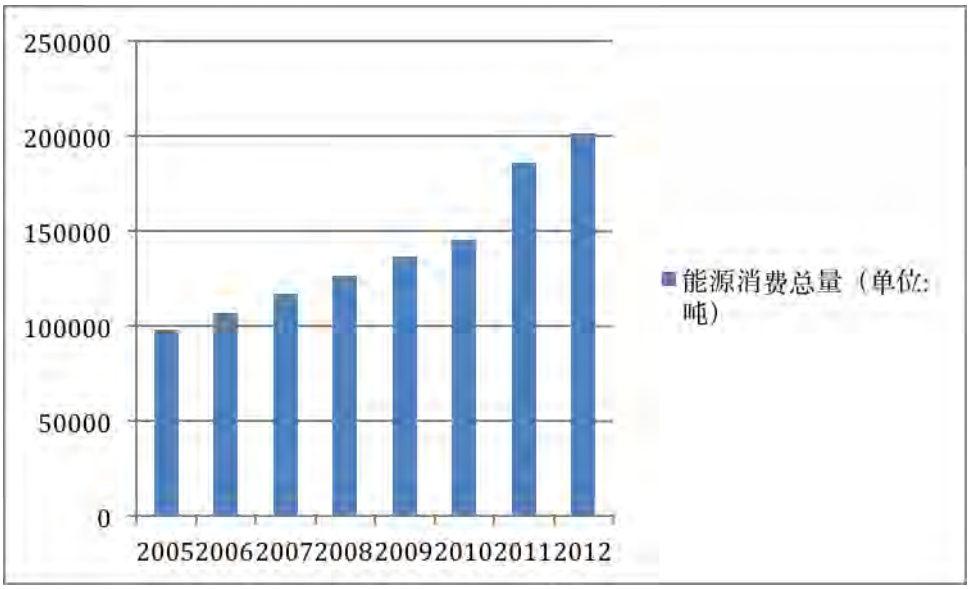


Fig. 2-4.2a Huangshan District's Energy Consumption Amount (2005-2012)

Amount of Energy Consumed (tons)

Relative to the country's average level, Huangshan district's energy consumption per capita and GDP energy consumption are low. In 2011, the district's per capita energy consumption was 1,143 kilogram of standard coal and the GDP energy consumption was 333.53 kg of standard coal/10,000 RMB;[76] the country's per capita energy consumption was 2,366 kg of standard coal and a GDP energy consumption of 700.33 kg of standard coal/10,000 RMB.[77]

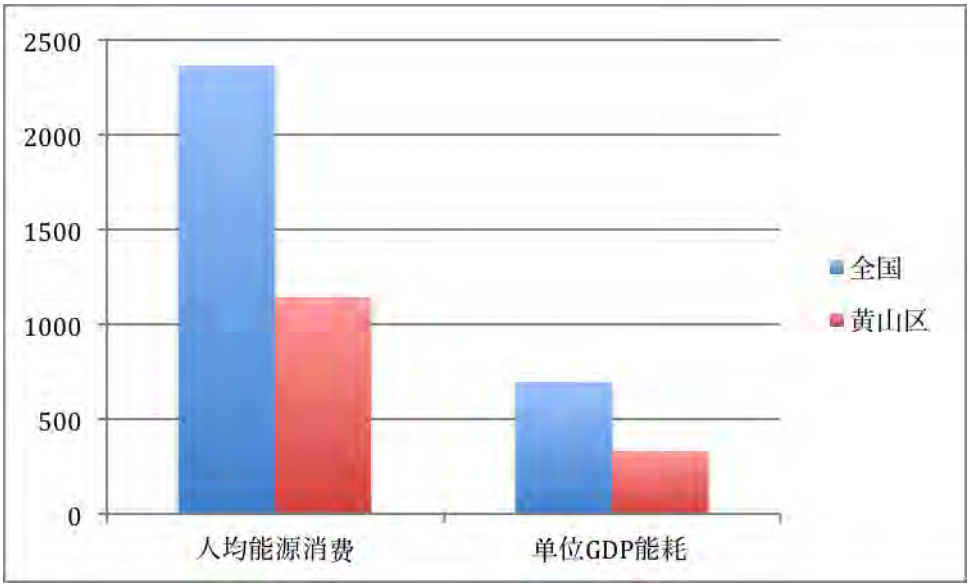


Fig. 2-4.2b Huangshan District and China's Energy Consumption per Capita and GDP Energy Consumption

Entire Country Huangshan District

[76] Energy Consumption values are from the Development and Reform Commission's data; population and GDP data are from Huangshan's Statistical Yearbook

[77] China's Energy Statistical Yearbook 2012; China Statistical Yearbook 2012

Huangshan district's energy consumption is divided into categories by energy source, mainly consisting of coal, coke, gasoline, kerosene, diesel oil, electricity and other. Energy consumption by resource for the years 2005-2011 is shown in the following figure.[78]

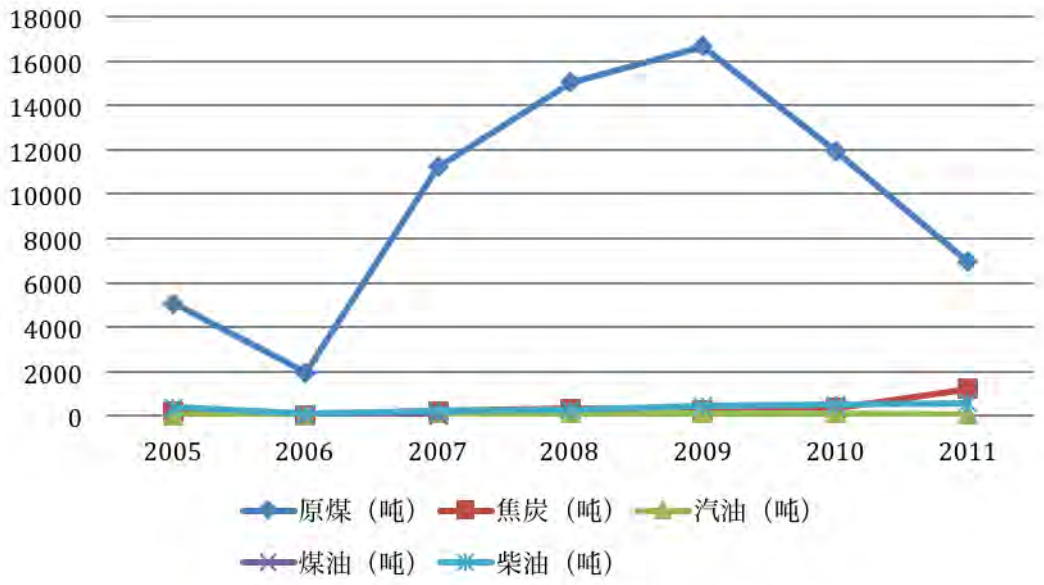


Fig. 2-4.2c Huangshan District's Main Energy Resources Consumed

Coal (tons) Coke (tons) Gasoline (tons) Kerosene (tons) Diesel Oil (tons)

As evident by the graph, Huangshan district's main energy resource is coal, reaching peak consumption in 2009 of 16,664 tons.

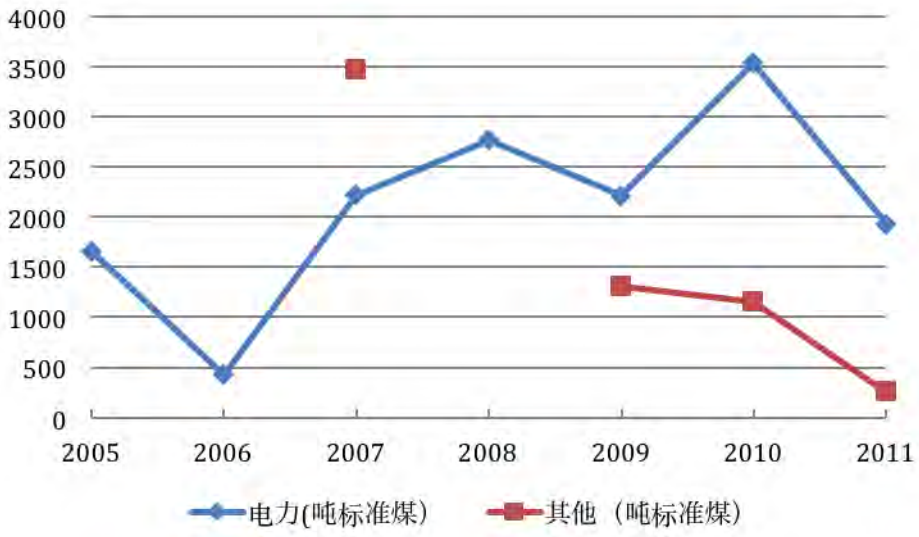


Fig. 2-4.2d Huangshan District's Electricity and Other Energy Resource Consumption

Electricity (tons standard coal equivalent)

Other (tons standard coal equivalent)

[78] Source: Huangshan District's Statistical Yearbook. Electricity's kwh units have been changed to fit tons of standard coal.

As shown in the graph, the amount of other energy resource used in 2007 was greater than the amount of electricity consumption. In the years 2009-2011, electricity consumption was greater than other energy consumption.

b. Energy Consumption Structure

Huangshan district's energy consumption is mostly from tertiary industry, making up 58% of the total. For China as a whole, however, it is secondary industry that consumes most energy, taking up 74.35% of the total energy consumption.[79] In 2012, the amount of energy consumed was 201,300 tons of standard coal, of which primary, secondary and tertiary industries account for 13,900, 34,300 and 116,900 tons of standard coal respectively. Residential consumption was 36,200 tons of standard coal, as shown in the figure below.[80]

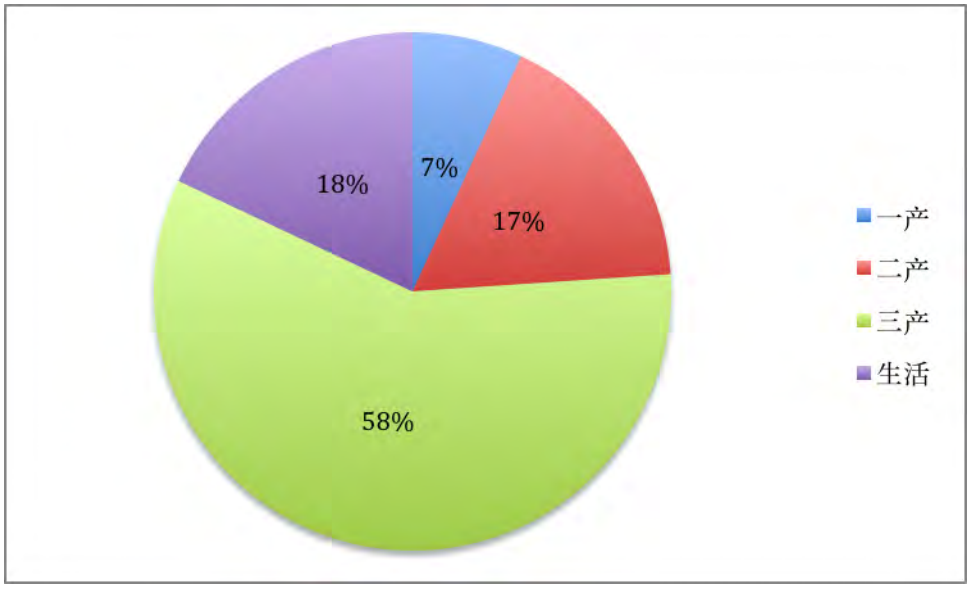


Fig. 2-4.2e Huangshan District's Energy Sub-sectors

Primary Industry Secondary Industry Tertiary Industry Living Uses

Huangshan district's tertiary industry's energy consumption has been growing at an increasingly rapid rate, with the speed of growth in 2011 at 60.5% greater than the speed of growth in 2010. The energy consumption of primary and secondary industries has not seen much change. Residential energy consumption has been increasing gradually.

Energy consumption as divided by industrial sector for the years 2006-2011 is shown below:[81]

[79] China Energy Statistical Yearbook 2012
[80] Huangshan District's Development and Reform Commission Statistics
[81] Source: Ibid.

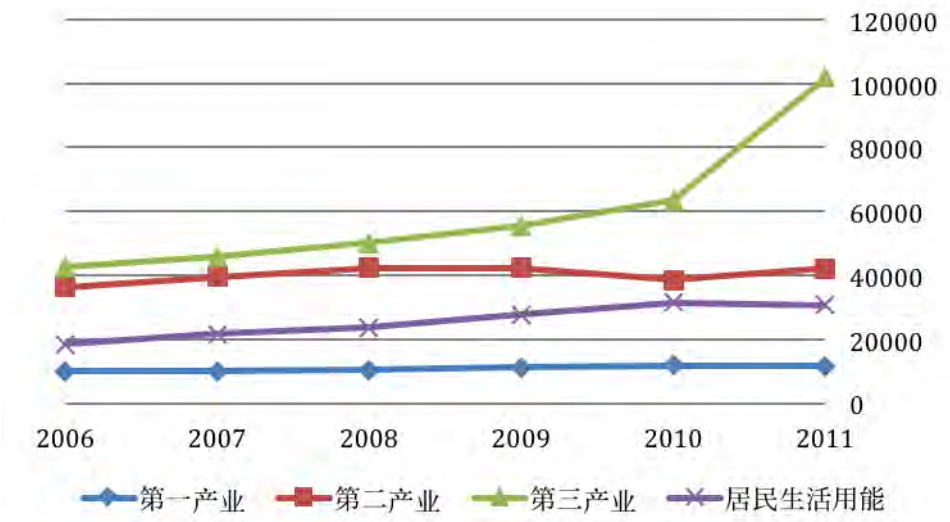


Fig. 2-4.2f Huangshan District's Energy Consumption as divided by Industrial Sector (tons standard coal)

Primary Industry Secondary Industry Tertiary Industry Residential Uses

c. Energy Consumption by Sector

Industrial Energy

In 2012, Huangshan district's industrial energy consumption was 15% of total energy consumption, of which, above-scale enterprises' energy consumption was 43% of all industrial energy consumed. In recent years, industrial energy consumption has seen a decreasing trend, with 2012 values 11.6% less than those of 2011, with above-scale industries 29.7% lower.[82] Such industries' main energy consumption is with "Non-ferrous metal smelting and rolling processing industry" which provides coal for about 90% of all energy used by above-scale enterprises.[83]

Household Energy

As shown in the figure below, Huangshan district's residential use of energy has been gradually increasing, with a slight fall between 2010 and 2011. The proportion of amount of energy consumed by residential reasons only rose in 2006 and 2007, with a decrease all other years.

[82] Ibid.
[83] Huangshan Statistics Bureau

Fig. 2-4.2g Huangshan District's Residential Lifestyle's Energy Use

Residential Energy Uses (tons standard coal)

Residential Use as a Proportion of Total Energy Used (%)

As evident in the figure below, Huangshan district's residential use of energy is mainly concentrated in rural settings, despite the decrease between 2010 and 2011. Urban residents' lifestyle energy use has been gradually increasing.

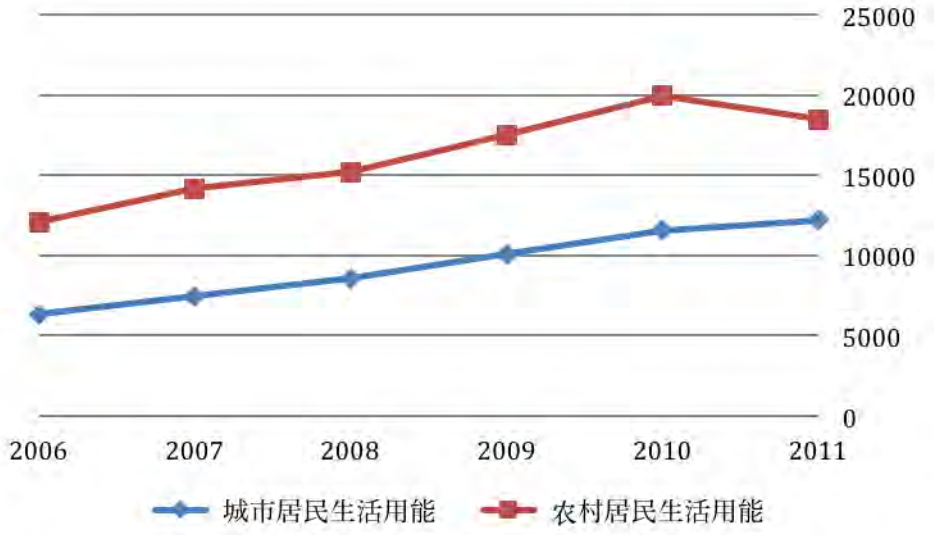


Fig. 2-4.2h Huangshan District's Residential Use of Energy (tons standard coal)

Urban Residential Use Rural Residential Use

In 2011, urban residential use per capita is 0.25 tons. Rural residential use per capital is 0.14 tons.

Transportation Energy

As displayed in the following figure, Huangshan district's transportation energy consumption has seen a steady (relatively) gradual increase, with the biggest increase of 61.81% occurring between 2010 and 2011. The proportion of energy consumption used by transportation slightly decreased between 2006 and 2007 but then continued to increase in the following years.

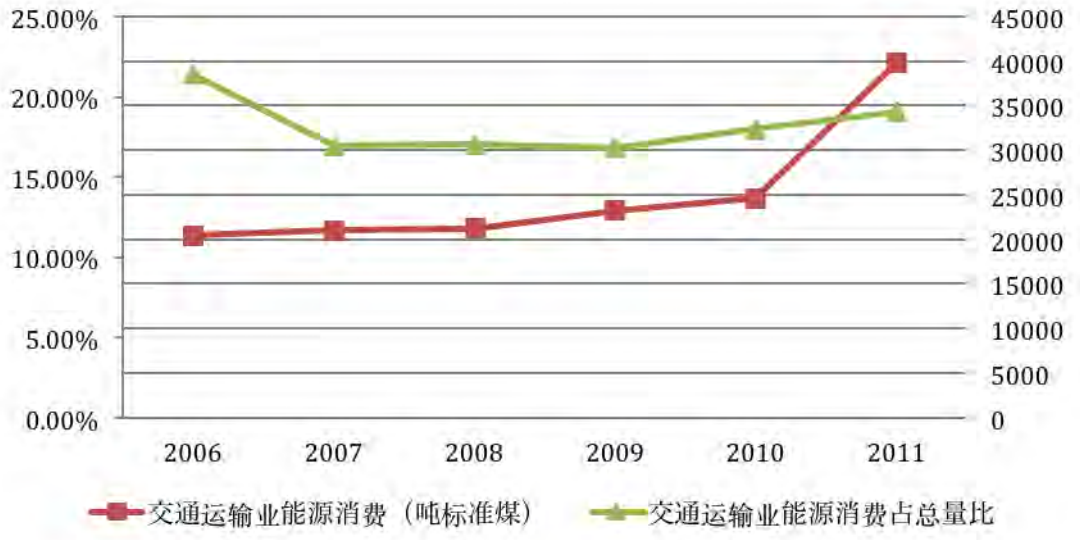


Fig. 2-4.2j Huangshan District's Transportation Energy Consumption

Transportation Energy Consumption (tons standard coal) Transportation Energy Consumption as a Proportion of Total Energy Consumed (%)

2.5 Infrastructure

2.5.1 Status of the built-up area

According to the 2010 Huangshan District land use change data, figure 2-5.1abelow shows how the land is split for natural and industrial purposes. By the end of 2010, the total area of the district was 8 km^2, which had grown from 4.5 km^2 during the years 2002-2006. The additional 3.5 km^2 of land is now the district's New District, southeast of the old part of the city.

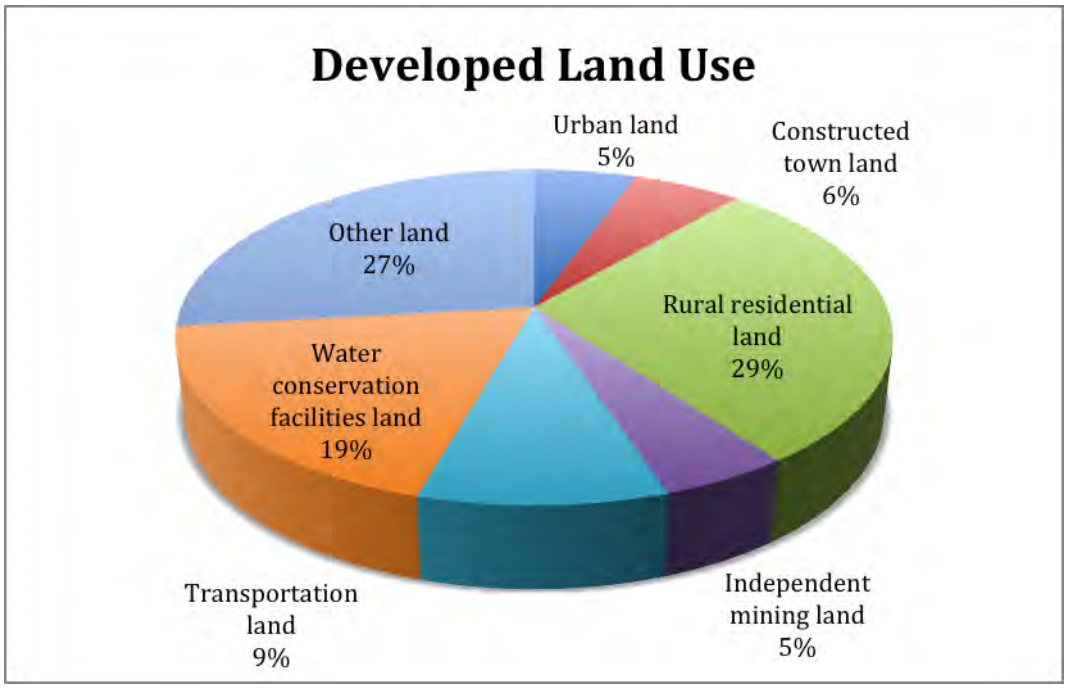


Fig. 2-5.1aBuilt-up Land Use of Huangshan

Figure 2-5.1b shows the floor space under construction and completed each year from 2002 to 2010. Although the data for years 2008 and 2009 are incomplete, the significant growth in construction is evident.

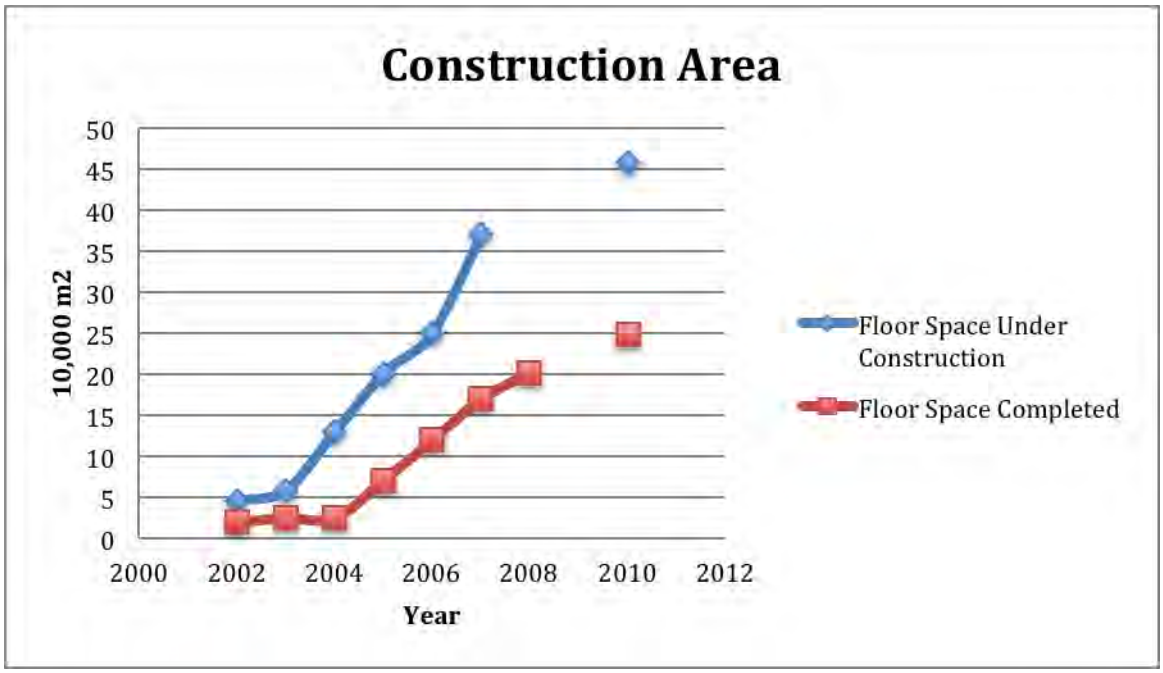


Fig. 2-5.1b Construction Area

2.5.2 Road conditions

Between the years 2002 and 2010, Huangshan's area of paved roads increased by over 300%, from 249,000 m^2 to 774,000 m^2. Although such road conditions are to minimize the minor traffic problems that the district is beginning to have, the number of cars is still not significant

enough for the city to build parking lots at shopping centers etc.; cars often find parking along the side of the road. With the development of the new southeast area of Huangshan district, many buildings are spread apart and the roads are noticeably wider in anticipation for an increase in vehicle density in the future.

2.5.3 Local transportation

In the HuangShan area there are no surface or underground railways. The main form of public transportation within the district is by bus or taxi. As of 2010, there were 40 buses and 47 taxis registered in the area. The district database indicates that the number of buses had increased from 30 in 2004 while the number of taxis has always remained at below 50.

Visitors within Anhui Province travelling to Huangshan Mountain are recommended to take bus or taxi from Huangshan city's main town – Tunxi. The bus fare is CNY 6.5 one way; although it only takes travelers to the towns nearest the entrances from whence visitors need to transfer to a tourist coach. More convenient transportation is by taxi at CNY 120 one way (70 km, 1.5 hours). Since Huangshan district is located on the other side of the scenic location from Tunxi, however, travellers can go directly to the North gate of the mountain instead of first travelling to Tunxi, which is located an hour to an hour and a half from the scenic area.

Most of local residents usually work near their homes and therefore do not rely heavily on transportation. For those who do not commute on foot, motorcycle is often convenient enough.

2.5.4 Intercity, provincial and international transportation

Given the relatively rural and small size of Huangshan district, all forms of intercity and international transportation depend on the larger Huangshan City and the nearby larger district, Tunxi. Huangshan City has an airport located in the Tunxi District (70 km, 1.5 hours from Huangshang Mountain), with flights to Beijing, Chendu, Guangzhou, Hefei, Shanghai, Shenzhen and Chongqing. The only international transportation that the city offers is by plane to Seoul, South Korea. The airport receives and offers flights from and to each city once a day at an average of CNY 1,000. The 50 minute flight from Heifei to Huangshan is usually midday at CNY 640. Major cities like Beijing, Shanghai and Seoul have flights twice a day at rates CNY1,090, 580 and 3,050 respectively.

The most popular form of transportation for long-distance intercity travel would be by train, with trains to Beijing, Shanghai, Guangzhou, Nanjing, Hefei, Jingdezhen, Nanchang, Xiamen and Fuzhou as destinations . The railway station is in Tunxi District's downtown area on QianyuanBei Road.

The two main bus stations in the city are the City Bus Station, which is located near the railway station in the center of Tunxi District and the New National Line Bus Station which brings tourists from neighboring cities to the foot of Yellow Mountain.

2.5.5 Status of Residential Housing

Residential houses are fairly new: the earliest neighborhood (xiaoqu) was constructed between 1997-2000 with most people moved in and the community completed around 2001. The apartments are on average 70-80 m^2, and often come with a separate complex for storage space or personal use. Originally the area cost ~800 RMB/m^2, escalating to 2000 RMB/m^2 for a second hand

apartment in 2009 and now it is about 3000 RMB/m^2. If rented out, the value of an apartment of about 70 m2 would be about 6000 RMB/year. Each building on average has four floors and does not have an elevator.

By law, only people with urban status citizenship are permitted to buy houses in the city. Many families of multiple generations, therefore, are squeezed under one roof. For a 70 m^2 space, it is not unusual for three or four people living within two bedrooms and two living rooms. Many people would like to move to larger homes but report that they can no longer afford the rising cost of housing.

Such expensive housing that many residents refer to, for example, is the apartment complexes in the New District. The new structures provide space of 93-142 m^2 with unit arrangements of 2/2/1 (bedroom/ living room/ bathroom), 3/2/1/, 3/2/2 and 4/2/2. Each floor is 2.9 in height and is comprised of two units, with 30-50 m^2 "garden rights" for each unit. The infrastructure used for such housing is an inorganic insulation material that provides better quality of thermal protection, is inflammable, strong and long lasting. These newly developed houses are on average 3,580 RMB/m2, which would take the average Huangshan lower-middle class citizen 8 years to pay off a 96-m^2 apartment, and only if they dedicated their entire salary to the cost of the house and nothing else.

2.5.6 Utilities (water supply and drainage, heating, city gas)

The utilities supplied to residential houses are often of good quality – with rare to no circumstances of power outages. On occasion that a city-run supply needs fixing, the neighborhood will be notified the date and hours for which they will lack power or hot water, etc. Some residents have access to the city gas pipes and others do not – largely because they have not requested for it rather than a lack of availability. Residents' utilities are convenient to attain by monthly payment fees due on a set date and location.

Figure 2-5.6 below shows the total length of sewage pipes throughout the city in the years between 2002 and 2010. From such graph, one can easily observe the exponential growth in city infrastructure.

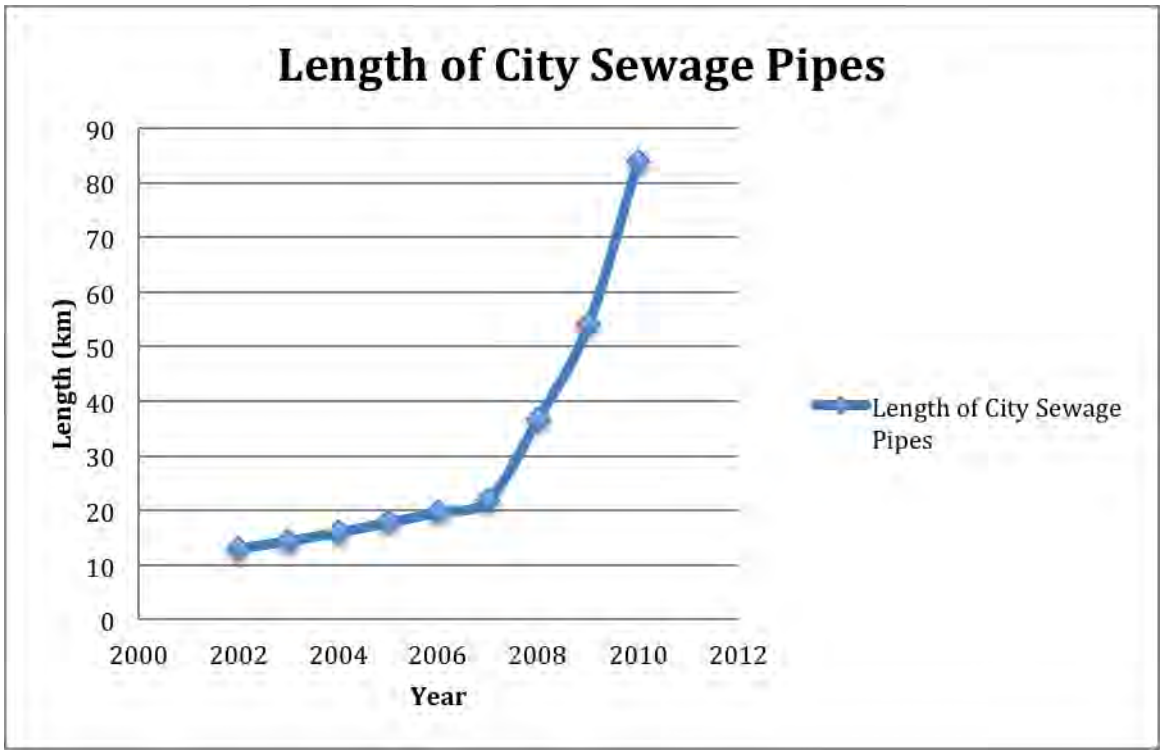


Fig. 2-5.6 Length of City Sewage Pipes in kilometers

3 Huangshan Sustainable Urban Development Goals

3.1 Analysis of existing government development objectives

During the past 10 years, thanks to physical locations and resources advantages, Huangshan District's development has always been tourism-oriented, supported by the industrial development, infrastructure construction, and urban development.

- With the national scenic district located in the area, tourism is the central force of the Huangshan economy. The goal of the government is to build a leisure resort district with international standard. Thus, tourism is the largest and pillar industry of Huangshan.
- At the same time, other industries are playing the supporting roles in the economy of Huangshan. In order to fully utilize the local resources, the development of an innovative industrial system is consisted with environmental friendly industrial manufacture of medicine and machinery manufacturing, minor hydropower construction, and agricultural products.
- Focusing on the infrastructure construction is to improve the infrastructure facilities of the townships, in order to enhance the people's living standard. Huangshan District has built Taiping Passenger Ropeway and monocable- stayed bridge, Lake Taiping Bridge. By the time when they were just constructed, they were both the best of world. Also, with the link of He-Tong-Huang Expressway, every town and village has constructed the complete infrastructure services including financial, business, communication, hydropower and other facilities.
- Urban development is also an existing objective of Huangshan. New urban built-up areas are under construction。
- Prominent social co-ordination

3.2 Overall description of Huangshan sustainable urbanization goals

During the "Tenth and Eleventh Five-Year Plans", by year 2000, per capita GDP and fiscal revenue, rural per capita net income of urban resident and s per capita income had reached over the provincial average. By year 2010, the GNP and per capita GNP had quadrupled the ones in 2000. Therefore, during the "Twelfth Five-Year Plan" and in the next decades, the overall strength of the industrial structure is aimed to further optimized. The secondary industries have a strong production capacity and potential to become an important pillar of the local economy. Furthermore, further strengthen and reform agriculture will continually be the foundation. However, in order to have a sustainable development, Huangshan shall focus more on the tertiary industry that will be accounted for a proportion of over 60% of the "Three Industries Model", rather than the environment-sacrificing heavy and manufacturing industries development.

In terms of external and foreign exchange, the international economic and cultural exchanges will become more widely. The district had strived to improve the basic framework of international tourist district for the goals of becoming modern international tourist city in the next 20 years. Significantly enhanced reception capacity will greatly improve the level of development towards the international standard. The improvement will make Huangshan a district of industrial tourist economy from a district of rich tourist natural resources. In terms of the tourist industry driving the expansion and urbanization of the Huangshan area, it would help if the district offered more than their natural attraction. Tourists would want to stay longer, and therefore would provide more jobs for immigrants, if Huangshan expanded into a year-round mountain resort, with recreational activities such as biking, bungee jumping and

spa resorts. The tourist resort of scale attracting and utilizing foreign capital will significantly be enhanced. Export volume proportion of GDP aims to be accounted for over 30%, becoming one of the most significant tourism export-oriented industries nationally. Different from the previous years of pace-oriented economic development, the next 10 to 20 years, the sustainable development is taking into account for the plan. The green development focuses on building a resource-saving and environment- friendly district, to firmly establish the concept of intensive conservation development. The more introduction of high-tech solution implements regional strategies ecological legislation and carries out energy conservation, cleaner production. Actively developing green economy, circular economy will promote green consumption, and strengthen the development of cost-effective, resource-saving, environment-friendly tourism leisure district.

In summary, Huangshan has abundant natural resources, benign ecological environment, with incomparable advantages in terms of the sustainable urbanization development. Based on the historical conditions, basal levels and strengths, Huangshan District economic growth should rely on the development of tourism, rather than sacrifice resources and the destruction of environment as the expenses of industrial development and rapid economic growth.

4 Analysis of Core Issues in the Urbanizing Huangshan

4.1 Existing issues of economic development

4.1.1 Economical Structure

In Huangshan District, its primary industry includes agriculture, forest industries. Its secondary industry is light and heavy industry (hydropower, manufacturing and etc.)and construction. Its tertiary industry includes everything other than the ones in the primary and secondary industry.

From Year 2000 to 2012, the primary industry of Huangshan District had been declining as a percentage of the region's gross domestic product (GDP), from 26.2% in 2000 to 11.4% in 2012. However, the second industry's share had been rising dramatically. During the same period, it increased from 17.6% to 40.1%. The tertiary industry's proportion declined slightly. Therefore, the supporting role of secondary industry in Huangshan District has been becoming more and more important. The overall development of the district has shown rapid industrialization. Having forestry as a main industry, Huangshan riches in forest resources with its forest area reached 128,533 hectares; the forest stock volume reached 6.84 million cubic meters; and the forest coverage rate increased to 75.6%. However, in 2011, the added value of forestry in GDP accounted for only 2.95%. It indicated a great development space. Meanwhile,, since the declining trend of the tertiary industry, the Huangshan district should develop the tertiary industry in order to promote the district's overall economic development.

4.1.2 Government Financial Conditions

In 2012, Huangshan district's financial expenses reached 1.442 billion RMB, with an increasing rate of 26.5% from the previous year. Its imbalance balance-of-payments caused local financial difficulties. There appear to be various reasons for the situation:

1) Poor economic planning, irrational industrial structure, and lack of the stable growth of income source;

2) Various newly introduced incremental policies (such as civil servant wage increases) increasing financial expenditures;
3) Unstable financial system increasing local financial burden.

4.2 Existing issues of Ecological and environmental protection

4.2.1 The safety issues and threats of the Drinking water

Up to now, Huangshan District has two important sources of drinking water. One is the water intake of a Huangshan No.1 water plant, located in River Puxi of Gantang town in Huangshan District, which serves urban and rural areas. The water intake's upstream, Zhanggeng Village, has a large number of farmers with an inefficient pattern of faming, which became a great threat to the safety of drinking water sources. At the same time, the residential sewage on both sides of the river has also become a major source of drinking water pollution. The other source is the No. 2 water plant, a backup source which has not been put in operation yet. Within the protection area of the water plant, there is no industrial plants or outfalls, but there are pollution sources upstream near the Yongfeng dam near the River Machuan in Xianyuan town. Therefore, the quality and safety of the water source cannot be guaranteed.

4.2.2 The poor quality of river water around urban and rural areas

According to the results from Huangshan District's major river water quality monitoring program, in recent years the water quality of the two rivers River Puxi and River Machuan have seriously deteriorated. In 2011, during Period "Water Bloom", these two major rivers' CODcr maximum index exceeded 30mg/l (Type IV surface water limit value). Between July and October, Chlorophyll a indicators, which can directly reflect the growth level of algae, are more than 10mg/L (>10mg/L indicating Eutrophication). The chlorophyll a indexes' maximum values at two monitoring stations Miyan Guan and Fuxi Kou reached 99.24mg/L and 206.3mg/L, respectively, indicating a severely eutrophic water body. These two major rivers flow through relatively developed townships with dense populations. For example, River Puxi runs through Town Gantang and Town Taiping Lake, and River Machuan runs through Town Sankou and Town Xianyuan.

4.2.3 The destruction of vegetation and landscape caused by irrational development

Along with the rapid growth of social economic and tourism development, the scale of Huangshan District's land development is continually expanding, but due to the relatively low level of economic and social development; unsustainable production methods; and the lack of professional knowledge and advanced ideas, the vegetation and landscape are being severely degraded from unorganized regional housing construction, road cutting and mining.

4.2.4 The degrading water quality of Taiping Lake, close to the threshold of the Second-grade drinking water sources protection zones

According to the results from Taiping Lake water quality monitoring in recent years, the COD_{Mn} concentration of lake water body reached the Class II standard in the Surface Water Environmental Quality Standard. During most periods tested, TP concentration reached the Class II standard as well. During certain months, the concentrations are inferior to the Class II standard. Also, overall TN concentration indicates a Class III standard, but in November of 2008, it didn't fulfill the

standard. To overview the trend of pollutant concentration, the degrading water quality of Taiping Lake is close to the threshold of the second-grade drinking water sources protection zones water quality.

4.2.5 The problems of solid wastes

Currently, Huangshan District has established a " District-Township-Village" three solid waste collection system, but this system hasn't been completed. Therefore, there are three factors causing the environmental threats:

1) Garbage collection rate and the harmless waste treatment rate is not high;
2) District landfill cannot meet sanitary landfill requirements without seepage control facility;
3) Residents discard and dump the household garbage on both sides of the roads and ditches.

4.2.6 The problems of rural environmental pollution

Agricultural production process uses pesticides, fertilizers causing point source pollution. Also, unsustainable farming practices exacerbate the deterioration of the quality of agricultural environment. A treatment facility for livestock manure, rural household garbage and sewage are needed, and the lack of these facilities is causing environmental pollution. Although some towns have built sewage treatment facilities and waste disposal facilities, the farmers continue to follow unsustainable practices. The weak environmental awareness on environmental contamination problem still exists.

4.2.7 The environmental shocks of industrial development

1) Tourism

In recent years, Huangshan District' s tourism industry has experienced rapid development with a large number of project being constructed. This development combined with the lack of overall planning and environmental protection has had a great impact on Huangshan District's environmental carrying capacity. Firstly, a large number of large-scale construction projects will reduce the natural conservation forest area, change the original ecological environment and destroy the ecosystem's integrity. Secondly, Taiping Lake, the surrounding tourism development and Huangshan District farming will also contribute to water pollution. Thirdly, the rapid growth of the tourism industry will bring a lot of tourists. Excessive visitor reception will cause a lot of resource consumption and waste emissions, increasing pressure on the environment of Huangshan District.

2) Agriculture

With the continuous economic and social development and the rapid growth of tourism and tourist reception capacity enhancement, visitors' daily consumption of agricultural products increased dramatically, which greatly promoted the rapid development of agriculture in Huangshan District. Huangshan District's tea and vegetable growing area continues to expand. Its aquaculture and special breeding industries have also been expanding, causing heavy use of pesticides, and fertilizers, also causing a serious threat to the ecological environment of Huangshan District.

3) Industries

Since the Eleventh Five-Year Plan, there has been the strong momentum in industrial development of Huangshan District. Industrial Parks appeared and gradually have improved. Industrial output has grown at an accelerating rate.

An increasing proportion of industry in the local economy includes printing, copper processing, non-ferrous metal smelting and so on. Enterprises involving heavy metals, molybdenum smelting, molybdenum chemical and so on are prone to environmental accident. The development of industrial enterprises not only must be considered in terms of Huangshan's economy, but also to its environmental quality and security.

4.3 Problems of social development

4.3.1 Loss of Human Capital

It is not difficult to find a job in Huangshan District, nevertheless, a well-paid one is rare to hunt. Lack of large- and medium-sized enterprises, Huangshan does not have a prosperous job market, even though the local unemployment rate of 3.82% was lower than the national average of 4.1% in 2012. Two major state-owned enterprises, a logging farm and a mechanical plant, finished privatization, leaving many laid-off workers to find new jobs unexpectedly. Because of a lack of large and medium size enterprises, Huangshan does not have a prosperous job market. Besides SMEs' businessman, civil servants and teachers receive good payment. For those who are not a college graduate, employment at government agencies and schools is fairly inaccessible. Most jobs available for the undereducated do not have a long-term contract, with payment usually ranging from 1000-3000 RMB/month. Those people can typically get a job in stores, hotels, or restaurants, but the salary is not enough for decent living. With the real estate price increasing, low-income people feel more living pressure than before. Seldom do college graduates (from universities out of town) move back to Huangshan – due to less attractive job opportunities. If the situation continues, Huangshan will face an enormous lag in human resources.

4.3.2 Education: Improved but not Perfect

Since Huangshan is a county level city, its K-12 education has various differences from large city school systems. First, the allocation of K-12 education resources is relatively even. Students go to a designated school according to their house address. There is the option of selecting a school other than the one near one's home but people typically lack the will to pay for such a privilege. Migrant workers and other temporary residents can easily enroll their children at nearby schools. For Huanghsan residents, there is no concept of Xuequfang: a residential Xiaoqu with a very good school. Based on our inquiries with real estate brokers, the real estate value of a Xiaoqu is not directly affected by the quality of the designated school nearby. The second difference between Huangshan's education system and that of larger cities is that financial capital input from various levels of government has seen a steady increase. In 2012, the contribution to education expenses from the government was 16 percent of all public expenses. There are no tuition fees for students ranging from grades 1 to 9 and students can also get textbooks for free. The gap between urban and rural schools is narrowing. The education bureau is spending an increasing amount of its budget on improving school buildings and other physical facilities in rural areas. Lastly, although there is no university in Huangshan district, the college entrance rate has remained stable compared to that of other cities nearby.

However, problems do exist. The number of students per class is often between 50 and 60, making it very hard for teachers to provide enough personal attention at school. Additionally, the

social status of many working families creates a tiring routine that prevents parents from giving their children enough academic attention at home. Academic achievements are largely judged by the scores students get from exams. After school programs are not as diversified and qualified as what their counterparts enjoy in large cities, which possibly means teenagers lack opportunities to develop various talents. With the booming consumption of electronic inventions, many parents (their own education not surpassing high school) do not know how to control their children's searches on the Internet or how they spend their time on various devices. Considering these constraints from school, family and community support, researchers feel a growing concern for students' academic and other talent development in the long term.

4.3.3 The welfare system

The welfare network has been growing to cover more people than before. Like residents with urban Hukou (residence status), farmers can choose to join in the new rural cooperative medical care system (NCMS) since 2009. According to the statistics, a total of 125,926 people, accounting for 101.92% of the rural population, benefit from the NCMS in 2012 (the value being more than the actual number of rural residents because some have moved from their farms into town, while still using the same healthcare). A new type of retirement program designed for the elderly in rural areas is available too. The number of farmers taking part in rural endowment insurance has reached 6184, an increase of 290.2% over the previous year. Moreover, the new system of rural endowment insurance, with features of insurance and welfare, has been in pilot since 2009. All the above welfare programs coexist with older programs like urban and rural aid security system. Thus, the budget of social security has rapidly increased in recent years – other cities sharing similar experiences regarding public expenditure. In the first half of 2013, expenditure on retirement insurance was higher than insurance income. With the rapidly increasing need for healthcare and retirement pensions, in both urban and rural areas, governments on the central, provincial, and local levels have to face a long-term challenge.

For retired residents in Huangshan's urban area, the retirement insurance generally ranges between 1,000 to 3,000 RMB/month which provides for comfortable living, though not enough for residents to engage in substantial consumerism (purchasing new cars or apartments).

Additional subsidy is provided to migrants who had to move to the area from Taiping County, now Taiping Lake. Seeing as the land constantly flooded to the degree where their old homes are now underwater, these people have been struggling in alternative livelihoods, even with the limited 50 RMB/month subsidies from the government.

4.3.4 The low level of spiritual civilization

Huangshan citizens are not extremely religious and therefore there are barely any spaces of public worship throughout the district. For many tourist destinations in China, temples are a main attraction. Huangshan, however, relies substantially on its natural beauty to attract tourists rather than its religious history.

Although residents have no complaints about such lack of spiritual culture, all levels of government have paid more attention to religious development in recent years. Huangshan Development and Reform Commission formally approved plans for a Christian church in Gengcheng county with a total area of 2,990 m^2, 1,890 m^2 for the church and 1,100 m^2 for the reception center.

In addition, the Huangshan Buddhist Association was formally founded in the December of 2012.

As for the religious practices, local people seldom attend church or engage in religious activities. Every so often Huangshan Gantang Christian Church officials organize community service programs or give financial support to the local nursing home.

4.3.5 Wealth Gap

According to the 2012 Statistics Yearbook of Huangshan District, the annual net income per capita of farmers was 9,426 RMB, while disposable income of urban residents reached 20,346 RMB, more than two times famers' incomes.

Based on our survey, the difference between rich and poor does not create many social conflicts. Although residents did complain that their relationships with neighbors are not close, they admit that such aloofness has not caused by significant conflicts rather than a trend of people becoming increasingly more isolated.

Unsurprisingly, the source of such wealth discrepancy comes from education and background. Those (typically younger) who were privileged enough to attend college in nearby cities and find jobs in Shanghai, for example, move back to Huangshan having accumulated much more wealth than those involved in farming with less than a high school education trying to create a better life for himself by moving there too.

4.3.6 Medical problems

Even in the poorest neighborhood of Huangshan district, residents did not have many complaints about medical problems. Rather they said that a major factor of moving to their neighborhood was for the convenience of hospital treatment. Additionally, residents with rural citizenship can be treated at urban hospitals (though only with the insurance benefits of their original citizenship).

The largest medical concern mentioned by residents is the lack of care for the aging population, specifically those with children who have moved away from the area. Though Huangshan district has retirement homes, with fees of about 830 RMB/month and spacious living (there is room enough for everyone to have a single bedroom set up), many elderly refuse to stay there, preferring the comfort of home and care of their children.

4.4 Urban construction deficiencies

4.4.1 Urban Planning

Construction in Huangshan district follows the plans of Huangshan District Urban Planning Bureau, a department of the Huangshan district government. Since 2008, when the *Master Plan of Huangshan District(2008—2030)* was finished by the Bureau, the government's control over floor planning, whether for business, political use or public utilities, became more strict and taken more seriously. Huangshan district is described as a composite tourism zone in hilly area; in addition to visiting for the scenery, visitors come to hold business meetings, enjoy a vacation, and learn about ecotourism, etc.

The Planned Zone (83km^2) includes construction land in Gantang and tightly controlled space in the Gengcheng and Lvgunew districtsof the city. As displayed in figure 4-4.1a, the center of the planned zone is Gantang, which stretches out to the other districts.

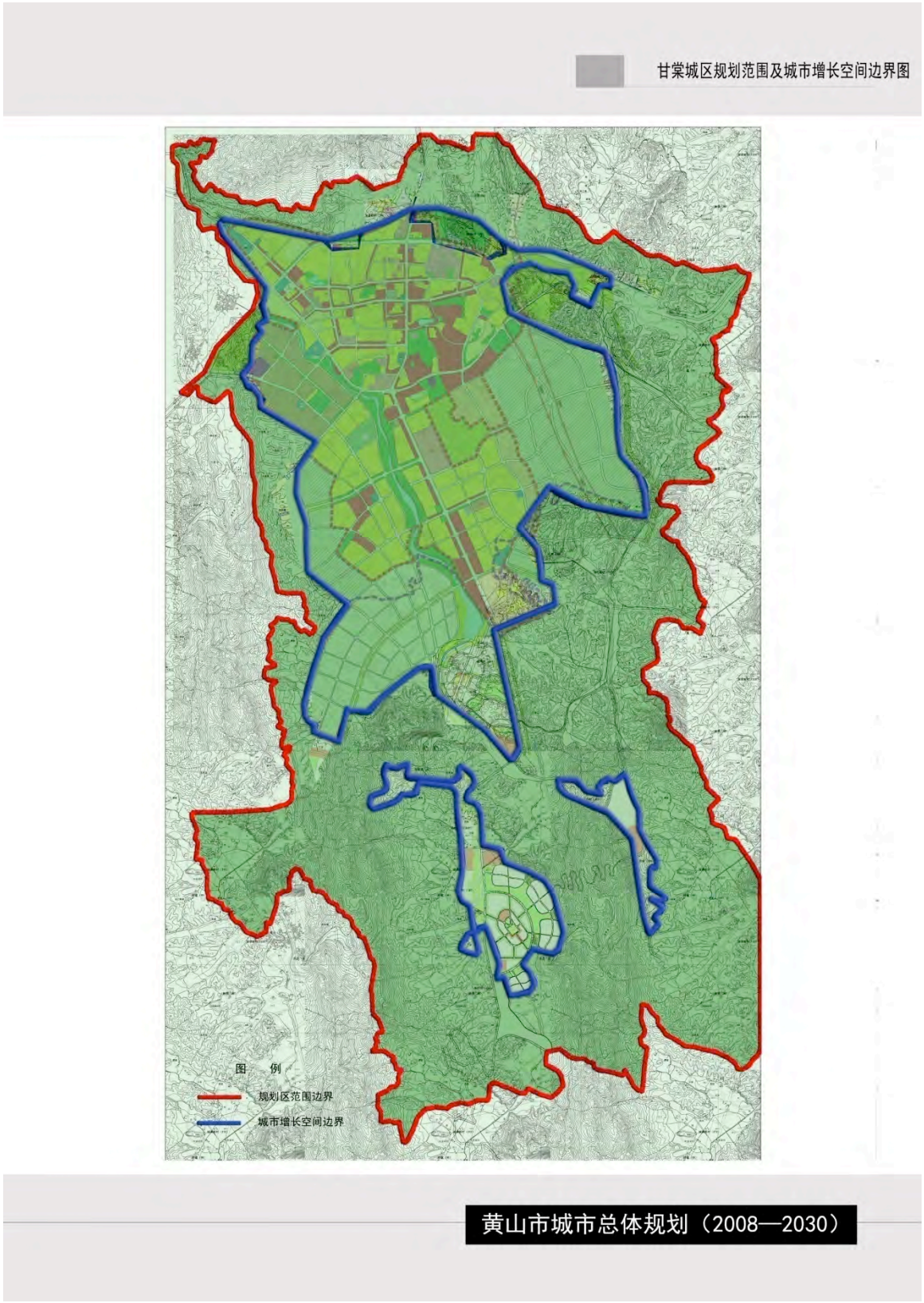


Fig. 4-4.1a Planned Area and Growing Frontier of Gantang

Source: *Master Plan of Huangshan District (2008—2030)*

The *Master Plan of Huangshan District (2008—2030)* is divided into 3 periods of construction and development: short term (2008—2015), mid-term (2016—2030), and long term (beyond 2030). The plan accounts for a rapid growth of population predicted for the district: from 66.8 thousand (2007) to 150 thousand (2030). Development between Gantang and Gengcheng will integrate the two parts of the larger district, especially in the southwestern and northwestern parts, until the district comprises 250 thousand people and up to 25km^{2}of land by the end of 2050.

The structure of Huangshan district is drawn as “one line, three pivots and three pieces”, (figure 4-4.1b) standing for different and independent functions:

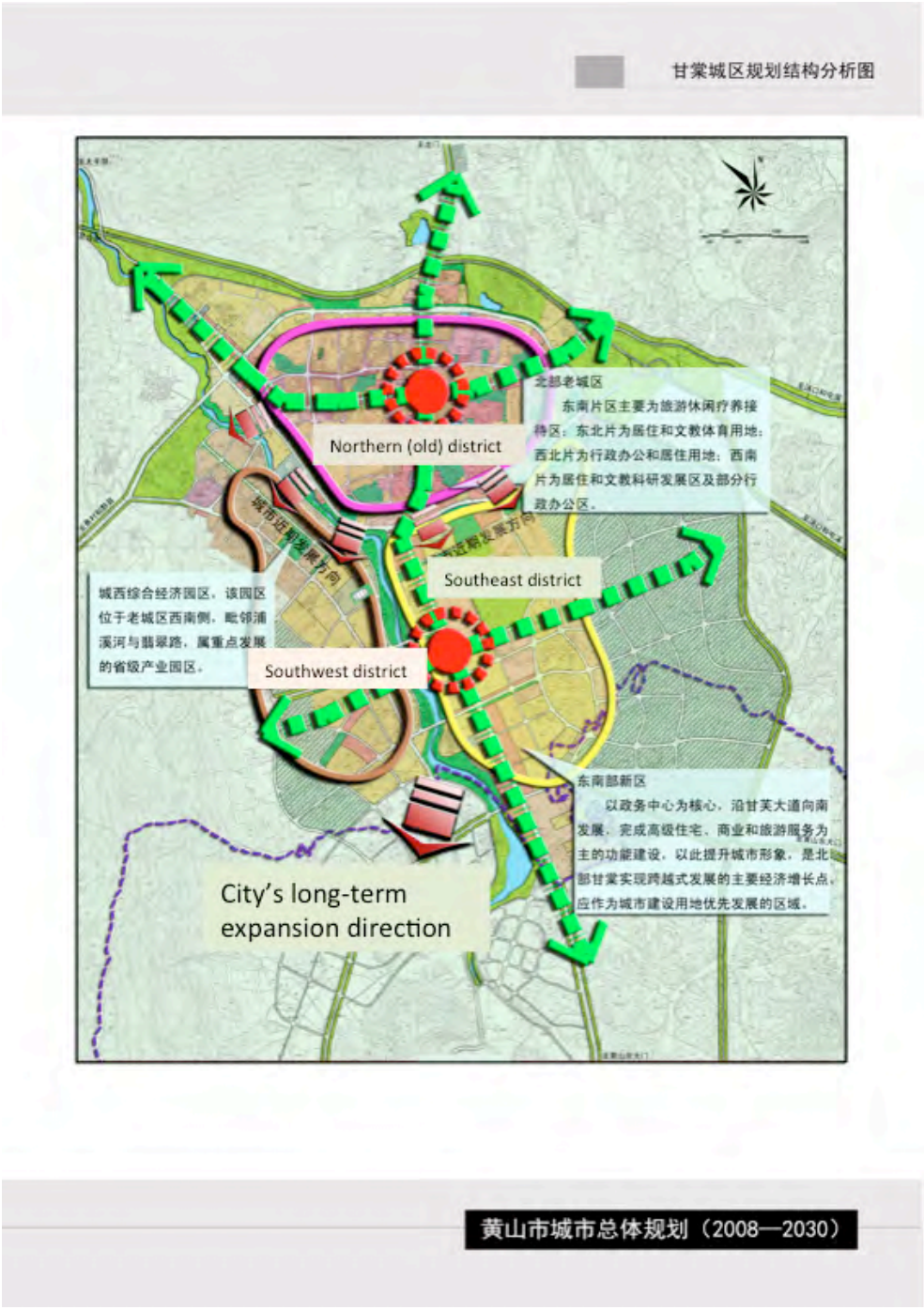


Fig. 4-4.1b Planned Functional Structure of Gantang

Source: *Master Plan of Huangshan District (2008—2030)*

- One Line: this area refers to Pu brook and its surroundings. River quality, mountain landscape and reforestation are the various aspects that are being monitored and protected to maintain the attractive and charming beauty of the scenery, mainly in southeastern part.

- Three Pivots: the 3 landscape axis, comprising Pinghu road for business, Beihai-Ganfu road for scenery and Keji road in the new area of city.

- Three Pieces: Huangshan divided into three parts – North district, Southwest district and Southeast district.
  - North district: the old area with many local citizens and historical estates, this place is developing from the city center, the business zone, and extends to the periphery. This piece is divided further: the southeastern area is for tourism and reception; the northeastern area is for residence, recreational activities and sports facilities; the northwest area is for government departments and several houses; and the southwest area is chiefly for residence and new technology companies.

  - Southwest district: located in the vicinity of Pu brook and Jade road, the district hosts industries, especially companies related to the local economy, like processing souvenir and agricultural products; environmentally friendly companies are also welcome.

  - Southeast district: because of residential living near Huangshan north gate, from which stems highways to other places in the province, this area is designated as the city's new developing point. Primarily providing tourism service, containing some hotels and shopping malls, the district is also starting to have new government buildings constructed there.

4.4.2 Shortage of Construction

Before the *Master Plan of Huangshan District(2008—2030)* was finished, the construction and land usage of Huangshan district mainly focused on the north district of the city, lacking an integrated plan and structural design(figure 4-4.2). Areas for business, municipal offices, sports stadiums and residential living were mixed up.

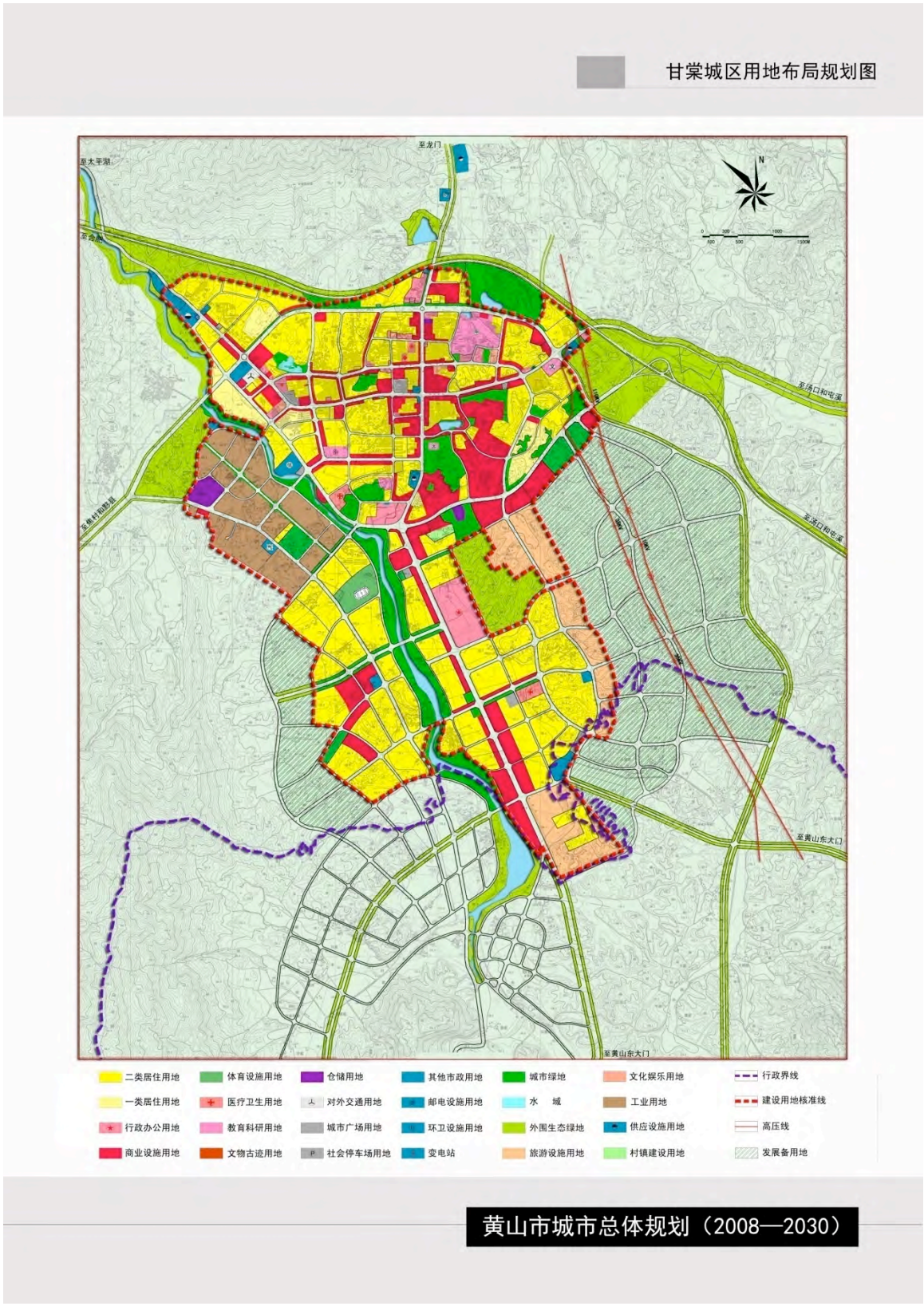


Fig. 4-4.2 Land use of Gantang in 2007

Source: ***Master Plan of Huangshan District (2008—2030)***

The construction of so many hotels and tourism facilities is unnecessary. The (long-term) population is only 66.8 thousand with an average income about 1,500 RMB/month per capita, fairly

low in comparison to the hotel living expense (300-400 per day). Thus, almost no local citizens can afford them for recreational escape, except for some local wealthy citizens. In accessible to locals, such services are used only by tourists. However, the climate of Huangshan district makes it suitable for only a few months each year; in addition, most tourists stay no longer than 2 days, buying limited number of products as souvenirs. Therefore, the purchasing power is too limited to support vast expansion of tourism hotels and other facilities, in terms of both native use and tourist consumerism.

Huangshan real estate has a large concern with success of sales – profit is limited and vacancy rate is high. A real estate sales manager in Gantang complained that Huangshan is appropriate for hiking instead of living, so a lot of sightseers, bearing this idea in mind, do not look toward Huangshan as a place to purchase a vacation home. His company's houses are mainly sold to people who have enough money to afford the rising prices and are connected with Huangshan locals, not to tourists. Five-star hotels have been built in Taiping Lake district and even with the potential of recreational development on the lake, there are still few people. The manager from Haizhou Grand Hotel in Tangkou revealed another issue: the land use for tourism in Tangkou is not enough to build commercial housing, thanks to its hilly landscape.

Lastly, although the *Master Plan of Huangshan District* prepares for the population to expand to 250 thousand by 2050, it is doubtful that Huangshan's population will actually reach this level. Not only is China transforming into an aged society, with not enough youth to replace the elderly, but also the younger generation continues to move to larger cities like Beijing and Shanghai to find work. A more modest hypothesis is that growth in Huangshan district'spopulation will not be so significant, that the master plan is a overly optimistic.

4.5 Problems with sustainable energy

The local government is lack of the renewable energy management, a unified survey of renewable energy resources and development planning. Also, the awareness of the economic and environmental benefits of renewable energy is not high. Local energy has not been fully exploited, especially as for the utilization of biomass energy.

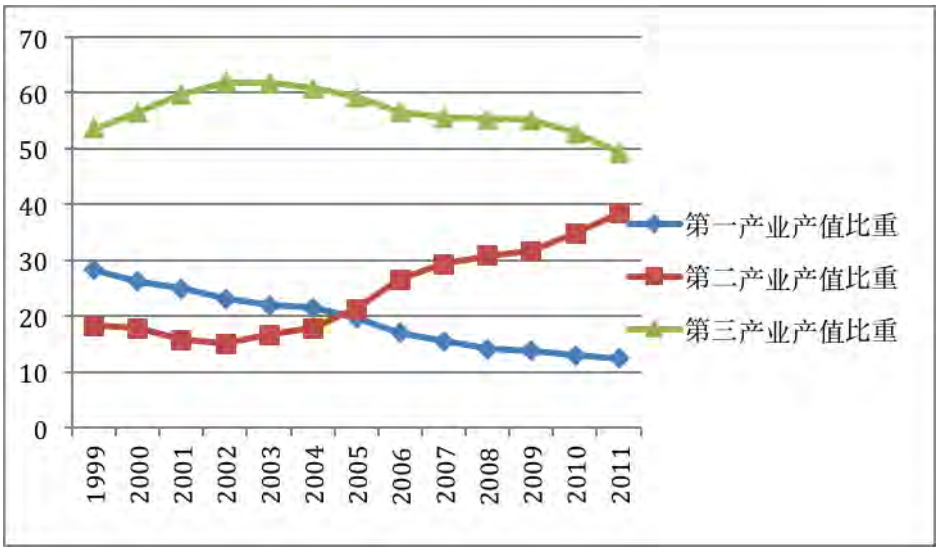
Since Huangshan's local resources are scarce, the district heavily depends on the external energy input and supply. In order to achieve sustainable use of energy is necessary to not only make fully use of local energy, but also save energy and improve energy efficiency, especially accounting for the largest proportion of consumption by tertiary industry.

5 Huangshan Urbanization Strategy

5.1 Economic Development

5.1.1 Tourism Industry

1) Huangshan Tourism Overview



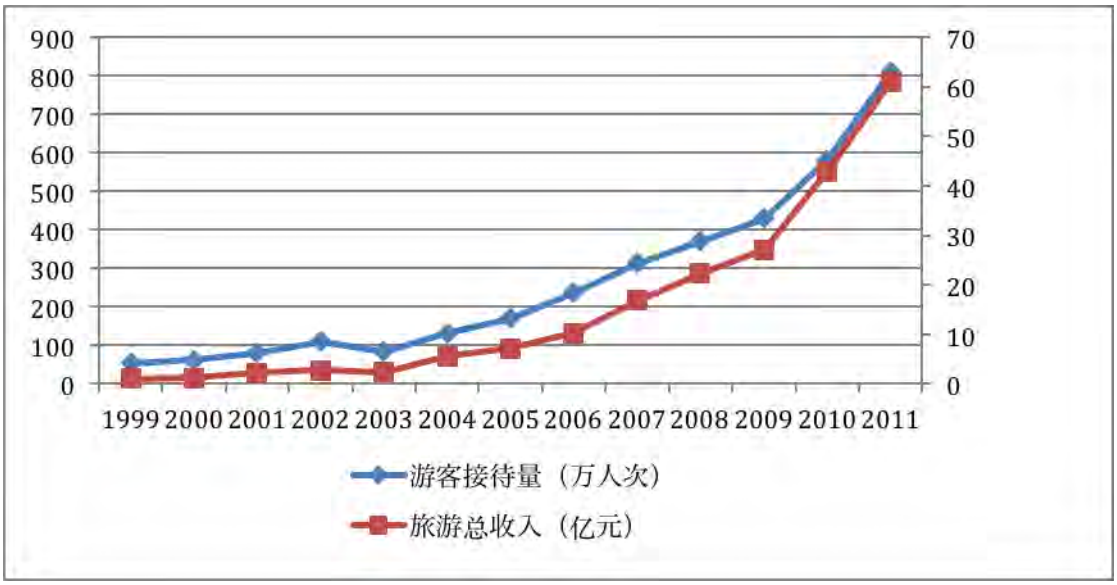
Proportions of Primary Industry, Secondary Industry, and Tertiary Industry

Figure 5-1.1a: Huangshan District Industrial Structure

Data Source: 2012 Huangshan District Annual Report

From Huangshan District's industrial structure, the tertiary industry takes the largest proportion. Since 1999, the proportion with less volatile has remained between 49% and 62%, which fully demonstrates that the tourism-centered tertiary industry accounts for more than half the proportion of local GDP. Therefore, tourism is the most important feature of Huangshan District industries and pillar industries. It should be noted that, Huangshan City, while diminishing its primary industry, its secondary industry is increasing year by year, from 18.2% in 1999 to 38.3% in 2011, indicating a booming period of the secondary industry in Huangshan District. The city is accelerating the pace of industrialization. At the same time, the proportion of tertiary industry, since 2004, has been decreasing year by year, down to less than 50% in 2011.

Huangshan District is the most concentrated area of Huangshan City's tourism. From the tourist accommodation and tourism in terms of total revenue, except 2003, the rest of the years showed increases in recent years. The growth has accelerated noticeably after 2003. Tourist accommodation went from 86 million visitors in 2003 to 432 million in 2009, an average annual increase of 30.9%. Similarly, total tourism income went from 240 million RMB in 2003 to 2.72 billion RMB in 2009, an average annual growth rate of 49.8%. Based on the two data, Huangshan tourism is in a stage of rapid development. It has become the region's most important pillar industry.



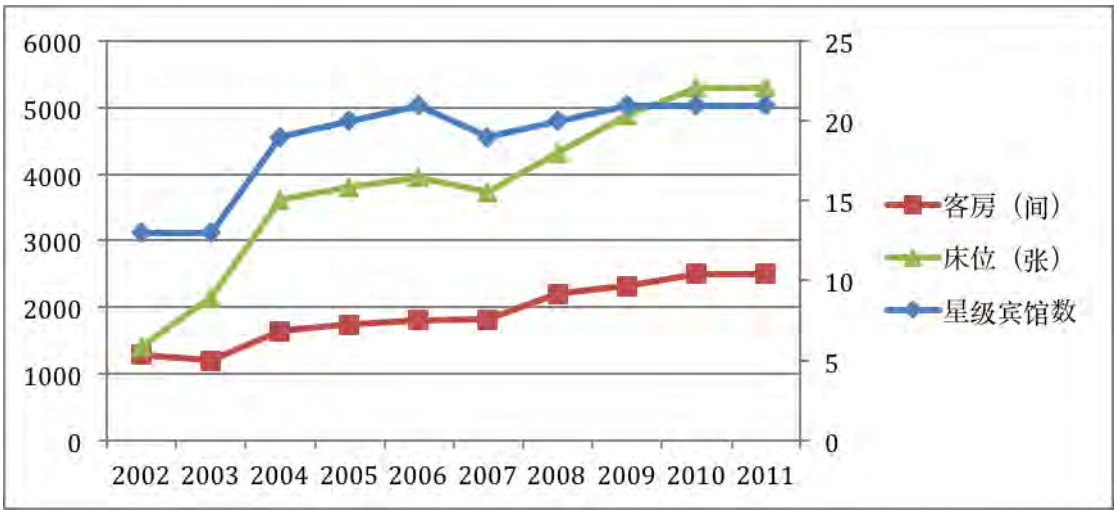
The Number of Tourists (10,000)

Tourism Total Income (100 million RMB)

Figure 5-1.1b: Huangshan District Tourism Development

Data Source: 2012 Huangshan District Annual Report

By promoting the development of the region's hotel industry, the capacity to host tourists has increased annually. As of the end of 2011, Huangshan has built in total of 289 hosting facilities of various types of hotels, restaurants and nursing homes, with 20,000 standard beds, including 19 star hotels, 1 five-star hotel, 3 four-star hotel, 9 three-star hotel. Star hotels' standard beds take 25% of the total number of beds. There are also more than 10 hotel constructions going on in the area. "Huangshan portal", Tang Town, has the most number of Star hotels in Huangshan District, followed by the town of Gan Tong where the government is located. From the graph above (Figure 5-1.1b), from the beginning of 2003, Huangshan District hotel industry has been rapid developing. The number of 1-, 2- and 3-star-rated hotels, number of rooms and beds went from 13, 1,193, 2,143,respectively in 2003 to 21, 2,312, 4,878 ,respectively, in 2009, respectively with increasing rates of 61.5%, 93.8%, 127.6% respectively, and average annual growth rates of 8.32%, 11.7%, 14.7% respectively. Therefore, if a huge number of hotels in the energy supply does not seek sustainable use patterns, there will be serious negative impact on resources, energy, and environment.



Hotel Rooms, Beds, and the Number of Star-level Hotels

Figure 5-1.1c: Huangshan District's numbers of Hotels

Data Source: 2012 Huangshan District Annual Report

2) The influences of tourism urbanization

Mullins (1991) was the first to propose the concept of "Tourism Urbanization" which means to meet the travel needs of the urban construction and development process. He took the famous Australian Gold Coast and Sunshine Coast as an example, describing the main features of this process as a consumer-oriented rather than production-oriented approach. Also he did this thorough analysis of the effects of urbanization on local tourism. The main indicator was that tourism urbanization increased the pace of urban development, including rapid population growth and labor supply growth, and improved the efficiency of governance. Tourism Urbanization changed the city's industrial structure, resulting in the majority of workers working in the tourism-related industry. Tourism Urbanization changed the city's population structure, resulting in more temporary staff and fewer families. Also, tourism urbanization caused high unemployment and lower personal income; and produced a number of negative effects on the natural environment and local residents living environment.

Nearly a decade of development fully reflects the influences of tourism development to the local economy. It promotes local economic structure and the process of urbanization. On the other hand, tourism urbanization has also brought many problems to be solved:

Key aspect of tourism economics:

- Excessively pursuit of the increasing number of tourists
- Excessively depend on the ticket revenues
- Decreasing growth rate of the average amount of tourists consumption and the average number of stay days

Key aspect of resources and environment:

- Destruction of forest vegetation and reduction of animal and plant resources
- Severe damage to the natural landscape
- Increasing tourism overload

Key aspect of tourism products and management:

- Lack of tourist product diversification;

- Inadequate infrastructure to support leisure recreations;
- Government agencies require strengthening;
- Uneven tourism development elements;
- Insufficient capital investment.

3) Tourism economic development model analysis

Resource Advantage

Huangshan's beautiful landscape, splendid culture, good ecological environment and rich tourism resources serves as the fundamental basis for its development. Environmental protection, imporoved planning and utilization are potential ways to better develop Huangshan's tourism trade.

Social Function of Tourism

Nowadays, Huangshan tourism industry's function plays a greater role than merely supporting its economy. It plays an increasingly significant role in promoting social development, meeting people's spiritual and cultural needs, and influencing the environment and other aspects of life in Huangshan. Thus, in planning Huangshan's future, thinking about how to enhance Huangshan's tourism industries becomes more critical than ever.

Although tourism has increased tourism foreign exchange earnings and maintained economic growth, its overriding function is no longer a single focus on economics. Particularly, in the many tourist-developed areas, the social function of tourism has exceeded its economic function. Tourism carries rich cultural connotations. Therefore, officials should integrate both the economic function and the social function as priorities.

From the micro-perspective, scenic and recreational functions are both essential. Comparing to the scenic function, recreational function has stronger connection with other industries, which leads to greater development of related tourism industries. Therefore, China's tourism industry must evolve from a single function to an integrated function. Huangshan Tourism has been dominated by natural sightseeing. However, it needs to include some leisure elements, since the single tourist sightseeing function cannot meet the current needs of the ever-changing market. It must combine scenic functional and recreational functions to have a better market share in the face of competition.

Product Development

Tourism market development includes fully exploring the potential of existing markets and developing new tourism market products. Tourism market development is closely related to tourism products. The successful exploration and development of the tourism market needs marketable tourism products, so the market demands for innovative tourism products is the necessary condition for creating a favorable economic environment. Thus, Active tourism market and innovative tourism products are the strong wings of the tourism economy.

Supporting Infrastructure Development

The district should further promote road transport infrastructure, municipal infrastructure,

information infrastructure, and other tourism infrastructure improvements, in order strengthen tourism services, entertainment and other aspects of the central city of Huangshan District.

Low-carbon tourism

Focusing on environment-friendly tourism presents an opportunity for Huangshan that is consistent with preserving its environment and culture. In order to accomplish this, greater attention will be required to develop circular economy, low-carbon economy and both a resource-saving and renewable economy. We will call all of these concepts collectively as "green economy".

Making Huangshan a "green economy" destination may attract visitors for its unspoilt natural beauty and to witness a green economy in practice. Further, by promoting development of energy-efficient, low energy consumption, lower emissions of carbon and other pollution, Huangshan will also strengthen its financial stability. Green growth patterns are the paths to realize the unity of economic benefits of tourism and social and ecological benefits of tourism travel. Below, we have identified several approaches that Huangshan can take to pursue a "green economy":

Promote energy conservation: improve energy efficiency of resource to promote the comprehensive utilization of energy saving, water saving, land saving, material saving and resource-saving during the development process;

Build a eco-tourism industry system: develop and promote eco-tourism products and a green modern service industry and other low-carbon industries;

Promote green consumption within the tourism industry: Promote green consumption and low carbon travel values to create a natural, healthy, modest, and economical and eco-tourism consumption patterns; guide local residents actively involved in eco-tourism; and develop more effective policy to encourage and promote eco-tourism consumption.

Strengthen environmental protection: Actively respond to climate change and take the road of low-carbon, in order to further promote the core tourist attractions and the broader environment, with particular emphasis on Taiping Lake District water protection, strengthening afforestation and urban greening projects.

5.1.2 Agriculture and Forestry

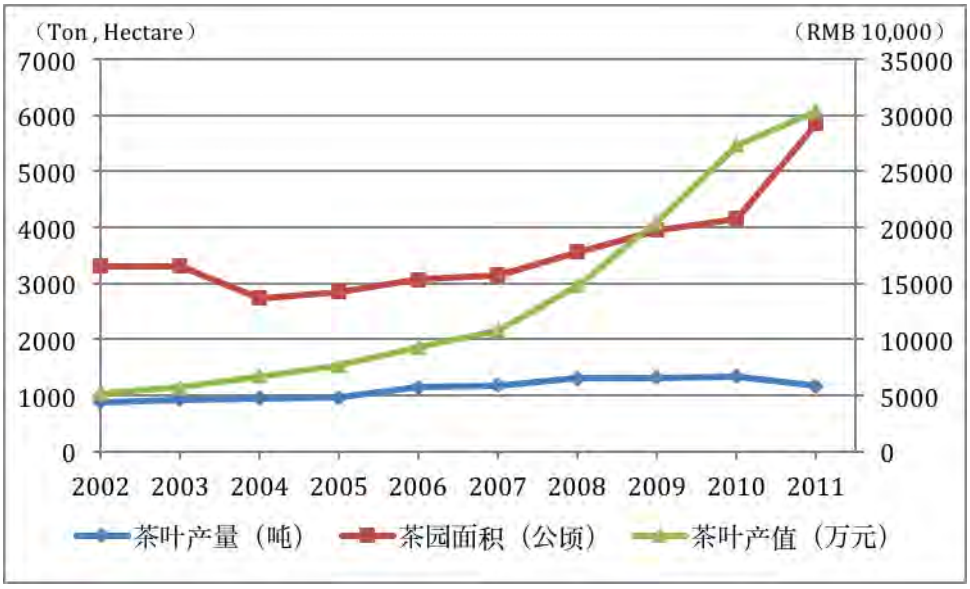
1) Huangshan District Agriculture Introduction

In 2011, the total production of agriculture, forestry, animal husbandry and fisheries reached 1.18 billion RMB, representing an increase of 614.94 million RMB from 2002, an average annual growth rate of 8.63 % Huangshan District is particularly strong in tea, vegetables and specialty aquaculture.

Tea Industry

In 2011, Huangshan's total tea production reached 304 million RMB, representing an increase of 252.065 million RMB from 2002. Figure 5-2.1a shows the change in land area devoted to tea production has experienced an upward trend after an initial decline, which went down to 2,737

hectares in 2004, and thereafter rose in 2011 to reach 5,862 hectares. From production point of view, after 2002, production increased almost simultaneously with the increase in cultivated area, from 880 tons in 2002 to 1,340 tons in 2010, then decreased to 1,163 tons in 2011.

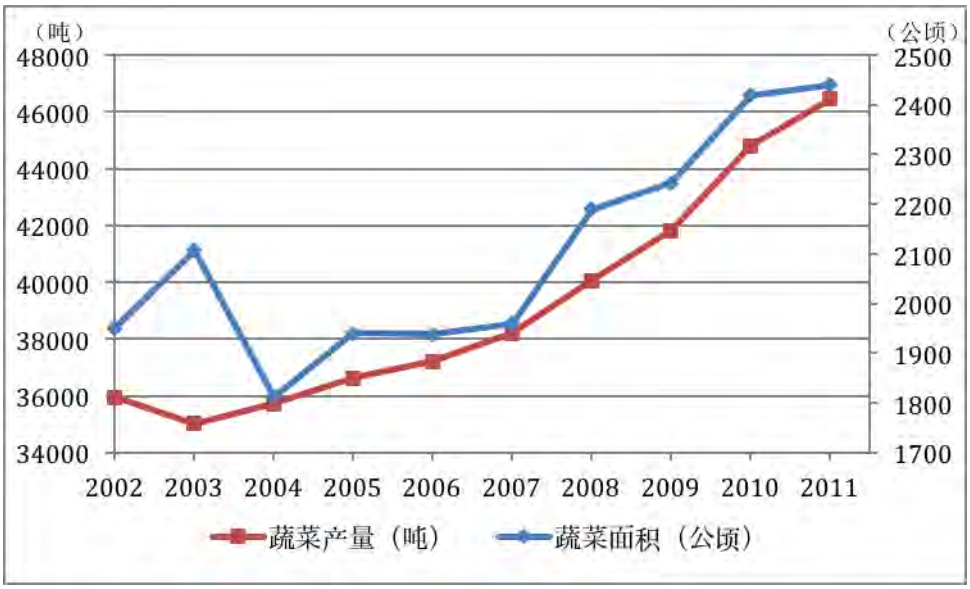


Tea Production (Ton)Tea Garden Area (Hectare)Tea Production (RMB)

Figure 5-2.1a Huangshan Tea Industry Productions

Vegetable industry

With the rapid development of tourism in the area of Huangshan and tourist reception capacity enhancement, visitors' daily consumption of vegetables increased dramatically. Visitors' demand for the local featured vegetables is also increasing, which greatly promoted the Huangshan District vegetable industry. Shown in Figure 5-2.1b, from the view of vegetable growing area, before 2004, vegetable-planting area experienced an upward trend. However, in 2004 it decreased by a great number, from 2,106 hectares in 2003 to 1,812 hectares in 2004. Since then, it has exhibited a generally upward trend. In 2011, it reached 2,440 hectares. Unlike tea production, vegetable production does not correlate as closely to recent acreage changes. In 2003, after a brief decline, it has been an upward trend up to 46,431 tons in 2011.



Vegetable Production (Tons)Vegetable Area (Hectares)

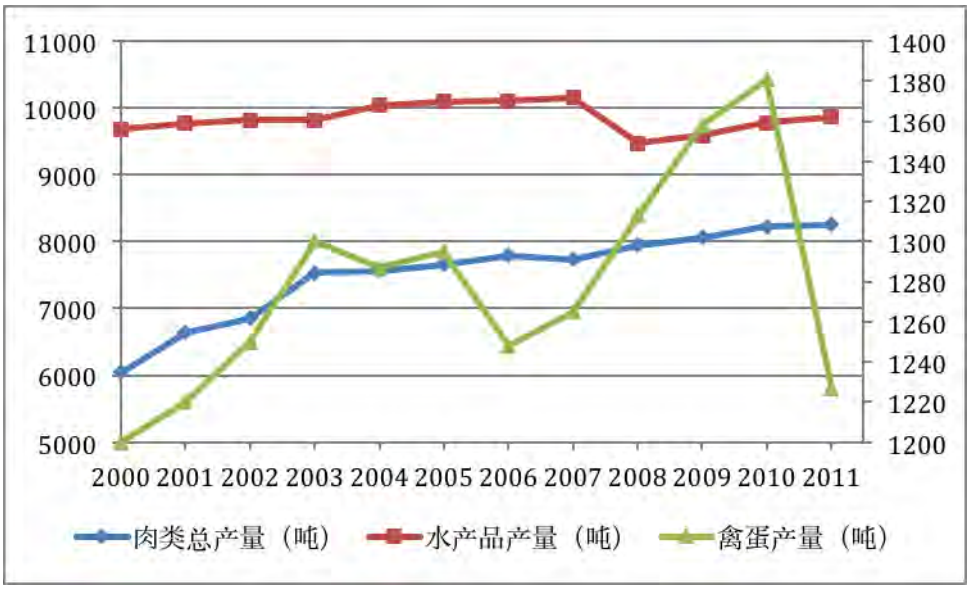
Figure 5-2.1b Huangshan Vegetable Industry

Aquaculture and livestock farming industry

In conventional livestock farming (see Figure 5-2.1c), livestock and poultry products, meat and eggs showed increasing trends in terms of total production, from 7,247 tons in 2000 up to 9,489 tons in 2011. However, currently, the total number of livestock is now declining (Figure 5-2.1d). There were two reasons: and epidemic during 2006 and the environmental requirements of tourism industry limited livestock farming.

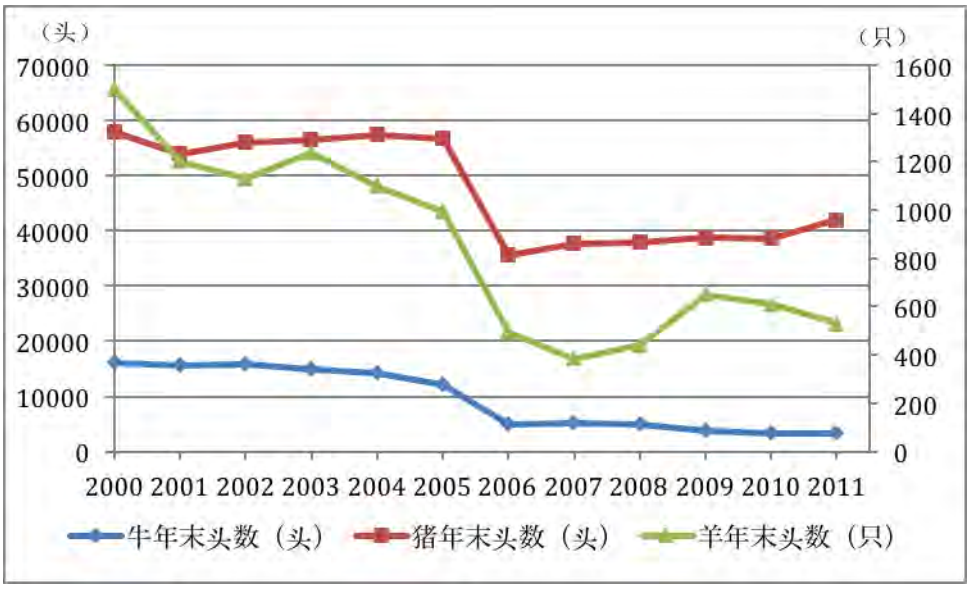
In terms of the aquaculture, in the last 11 years the Huangshan District has experienced fluctuations in production of aquatic products. It went from 9,686 tons in 2000 up to 10,160 tons in 2007. Then, it dropped to 9,475 tons in 2008, and later increased year by year reaching 9,868 tons in 2011. Notwithstanding these trends,in special aquatic products, due to the special Taiping Lake water quality conditions and higher requirements for the development of tourism on the environment, Huangshan District has a strong competitive advantage and techniques in breading organic fish, giant salamander and rana spinosa. In 2010, it has more than 4,000 species of frogs, 20,000 adult frogs, 40,000 breeding frogs, more than 10,000 tadpoles, and 25 acres of aquafarming.

In terms of special livestock, the rapid development of tourism stimulated the demand for specialty poultry products. So far, livestock products mainly include the current special wild boar, pheasant, USA king pigeon, rabbit, parent breeders and free-range chicken with production numbers of 300, 10,000, 3000, 25,000, 20,000 and 15,000, respectively.



Meat Production (Ton)Aquatic Production (Ton)Livestock Production(Ton)

Figure 5-2.1c Huangshan District Aquaculture



Cattle end year numberBoar end year number Sheep end year number

Figure 5-2.1d Huangshan District Livestock

2) Huangshan District Forestry

In 2011, Huangshan District had total land of 2.46 million mu (1 mu = 0.0667 hectares) including forest land 1.93 million mu accounting for 78.3%, of which 1.23 million mu as commercial forest and 69.69 million mu as ecological forest. Its forest stock volume reached 6.84 million cubic meters with an increasing rate of 75.6%. Huangshan District currently conducted two Provincial Nature Reserves: Kowloon peak and Shili mountain, two District-level Nature Reserves: Xi Stream and Heaven Lake. Protected areas reached 161112 mu, accounting for 6.5% of the total land area. Taiping Lake National Wetland Park area reached 14.78 million mu, accounting for 6% of the land area. In 2011, Huangshan District forestry industry production value reached 2.71 billion RMB, an increase of 254.17 million RMB within 10 years. Of that value, forestry primary industry, secondary

industry and tertiary industry production values were 595.78 million RMB, 462.98 million RMB and 1.65 billion RMB in 2011, respectively (shown in Figure 5-2.3a). The 3-industry structure had a ratio of 22%: 17 %: 61% in 2011 (shown in Figure 5-2.3b).

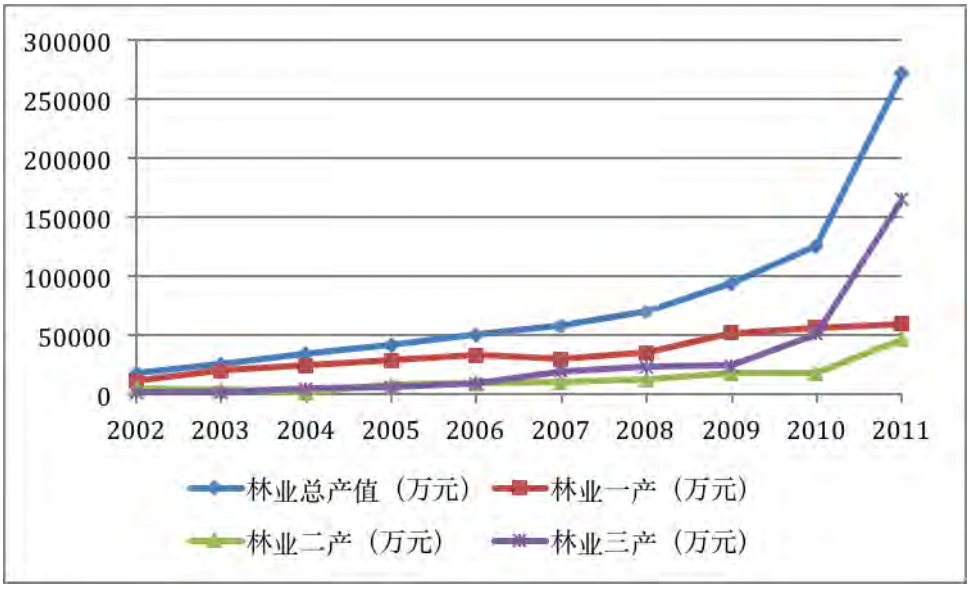


Figure 5-2.3a Huangshan Forestry

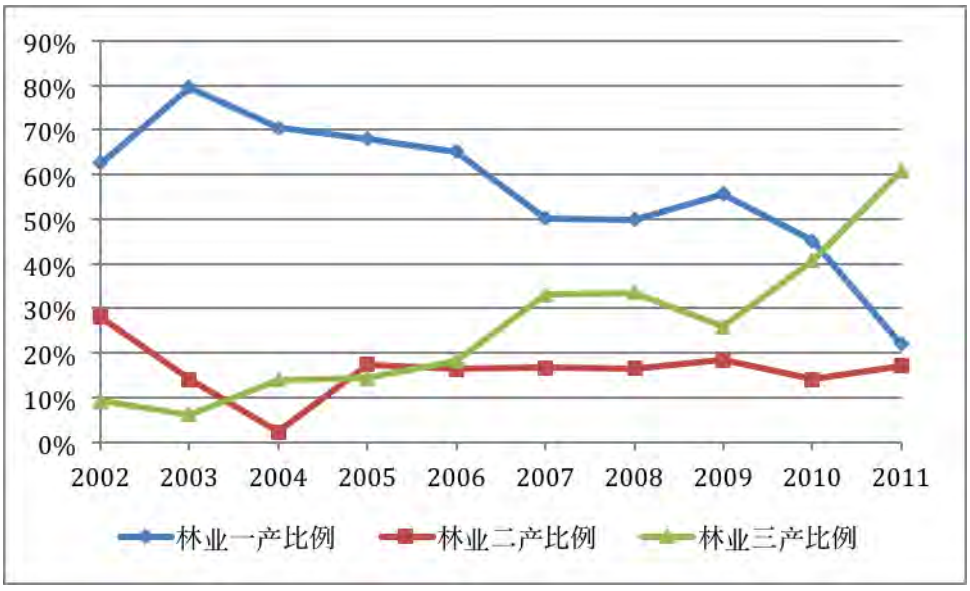


Figure 5-2.3b Huangshan Forestry

3) The major issues of Huangshan District's Agriculture and forestry Development

Agro-industrial development:

- In addition to tea, bamboo and other traditional industries, the level of agriculture development remains rudimentary. The level of processing agricultural products is still in the primary production level;

- The combination of modern agriculture development and "Huangshan Tourism" is not presently compatible. Huangshan's agricultural products have not achieved brand recognition. There is a failure to fully grasp the "Huangshan World-Class Brands and Tourism" opportunities..
- The pesticides and fertilizers used in agricultural production process, resulted in non-point source pollution. Also, unsustainable agricultural farming exacerbated the deterioration of environmental quality.
- Huangshan urban area's population is less than surrounding counties. Therefore, the surrounding counties have lower labor costs than the urban area.
- Agricultural infrastructure projects are weak and incompatible with the needs of modern agricultural development, which is leading to serious waste of resources.
- Modern agriculture has not yet become dominant in Huangshan District. This does, however, present opportunities to introduce green farming techniques to advance current practices

Forestry industry development:

- Relatively large areas of natural forests are rendering low economic and ecological benefits. This is due to underutilization of intensive management;
- The forestry industry remains focused on primary level products. Forest products of secondary industry are focusing on the primary level products which involve low-tech, raw material consumption and low added value;
- "Forest-based tourism" tertiary industry is developing at a slow pace with poor infrastructure, low levels of management and organization know-how.
- The destruction of forest resources still is occurring, causing declining wildlife populations. Enhanced capability to prevent forest fires and take measures against dangerous forest pests is needed.
- Insufficient forestry capital investment: A wide gap exists between public finance investments in forestry and the needs of forestry development. The potential of social forestry investment has not yet fully recognized; at the same time, the rise of social development and economic growth cause a significant increase in the cost of labors. It results in increasing the cost of afforestation. The afforestation subsidy is too low, which affects social forestry initiatives negatively.
- Inadequate forestry development mechanism: Forest management mechanism is oriented to solely economic considerations. Preservation lacks systematic management. The forestry legal system is not complete, and some legal provisions and practices exhibit large gaps.

4) Development Model

Agriculture Development Model

- Ecological priority

  Huangshan District agricultural development must emphasize the principle of ecological priority, in order to accelerate the transformation from traditional agriculture to modern agriculture; from decentralized agriculture to integrated agriculture park and rural residents from rural communities to modern centralized agricultural communities. The model aims to improve agricultural efficiency, increase farmers' incomes and promote rural prosperity.

- Integration of the development of modern agriculture and tourism

  Huangshan District has a unique natural environment and favorable ecological conditions. "Huangshan tourism" properly positioned could determine the modern agricultural development in order to unite agriculture with with Huangshan tourism industry development. The most relevant industries with modern agriculture development are scenic agriculture,

experiencing agriculture; rural tourism and farm enjoyment must integrate with Huangshan's natural landscape and cultural heritage.

- Agricultural industrialization and brand strategy

  Thanks to the favorable ecological environment, Huangshan District is able to promote the development and arrangement of tea, bamboo and special aquaculture and livestock in accordance with high-yield, high-quality, efficient, ecological, safety requirements, combined with the development of tourism. Thus, it can further promote agriculture development, actively implement the agricultural brand strategy and enhance market competitiveness.

Forestry Development Model

- Ecological priority

  Huangshan District's excellent ecological environment should be fully deployed to promote forestry and developing related industries, adhering to the "Ecological priority, Balancing ecological, economic and social benefits" principle, in order to effectively promote the tourism industry, wood industry and the sustainable development of eco-industries.

- Forestry industry development

  According to the development model of "Consolidate primary industry, Develop secondary industry and Improve tertiary industry" and based on the conditions of the current market, Huangshan District should focus on developing the eco-forest, bamboo forest, specialty fruit and nut trees, natural herbs and conservation of rare and endangered plants Wannan mountainous.

- Accelerate the transformation and upgrading

  With bamboo and forestry specialty products processing and eco-tourism, Huangshan can promote forestry secondary and tertiary industrial development, strive to achieve forestry development pattern, and speed up the development of forestry industry.

  Firstly, further develop wood processing industry to expand the timber processing industry to higher value-added products, and to encourage enterprises to increase efforts in upgrading equipment and products, and creating its own brands;

  Secondly, to actively attract a number of large enterprises and groups to achieve the introduction of high quality brands, in order to promote the region's forestry processing industry to become bigger and stronger;

  Thirdly, based on its rich ecological resources in the Huangshan and Taiping Lake scenic areas and the Taiping Lake National Wetland Park and Huangshan national forest parks, Huangshan district can develop eco-tourism , ecological culture, ecological education, ecological research and other new industries related to forestry and agriculture, especially to promote the rapid development of forestry tertiary industry;

  Fourthly, to develop sustainable forestry and ecological farming, to promote a wide range of forestry-related products including in the poultry, livestock, herbs, health care, energy, vegetables, tea forest, drugs and other types of agricultural products. To highly develop regional forest featured food, tourism products, medicine and health products, to build the region's name for ecological forest products, in order to achieve the transformation from the use of

traditional single timber to comprehensive development and utilization of resources, and fully exploit the double benefit of forest ecology and economy.

5.1.3 Real Estate

Real estate's main target audience is one who has enough money to pay for the rising cost of housing, most likely someone from out of town; in such case, they are often only able to attract someone who has enough prior relations to Huangshan, either through work or friends, to consider moving there long-term. Development of higher-income industries could play a role in Huangshan's future development of its real estate market.

With the development of Huangshan as a major eco-tourism destination and other proposed developments in the education and sustainable agriculture and forestry sectors, Huangshan should also consider its policies to develop real estate in a manner that supports its economic, ecological and cultural goals. This section discusses how the real estate sector can contribute to Huangshan's future development.

1) Huangshan District real estate overview

In Huangshan district, real estate is split between land that is available for development (in the construction, industry, tourism and education sectors) at 4.84%, and land that is preserved for forest and agricultural purposes at 92.4%, with the remaining 2.75% of land under an "unused" status. The Chinese real estate system for the last several hundred years consisted of government owned property and building structures that were available for citizens and companies to rent. In the 1990s, the government opened to citizens the opportunity to buy their own land, at which point the value of property began its steep rise: i.e. from 900-1,000 RMB/m^2 in 2002 to 2,000-3,000 RMB/$m^2$by 2007.

The current system consists of a government department, the Huangshan City Planning Bureau, which determines where people can and cannot construct buildings. They essentially divide the district up by zoning - the areas generally defined between civilization, forestry and water and more specifically defined by designated forms of development. In planning, they allocate certain lots of land to schools and hospitals then split most of the rest between commercial, business and residential use. Once designated for a given purpose, the land can be bought and developed by anyone, within certain limits in terms of size and space remaining under the jurisdiction of the bureau.

As the district continues to grow, the bureau takes into account preservation of the surrounding natural beauty by giving developers a Volume Rate. Thus, as a real estate company is subject to limits to build houses of a certain size and total area, including number of floors upward. Additionally, they are required to reserve a portion of their lot to greenery. The Volume Rate is not a designated number for the entire district; it ranges in size depending on the purpose of development.

2) The development of the real estate industry – analysis of the strengths and opportunities

Because the district is located between Taiping Lake to the north and Huangshan Scenic area to the South, the development of land is restricted to its current location, with exception to the southeast area. Known as the New district, new developments south of the Old Huangshan district is focused primarily on tourism, similar to the majority of Huangshan city. From the original ~7 km2

space, the Huangshan City Planning Bureau set development of 10 km^2 by 2015 and a total of 15 km^2 by 2030. With growth at this rate, urbanization is expected to have only a modest impact on the natural surroundings.

Although this limits the development potential of real estate in terms of land expansion, this increases the value of real estate within the district. What was a value of 1,700 RMB/m^2 six years ago is now over 3,300 RMB/m^2 for residential spaces. At such rate, real estate costs are estimated to grow, perhaps near the 4,000 RMB/m^2 at Taiping Lake (what is there closest developmental rival). For commercial use, street level floor space is often sold at 6,000-7,000 RMB/m^2. The positive aspects of each are the lack of restrictions on use. Thus, residential housing can be rented, instead of bought, at a cheaper price. Additionally, any commercial industries interested in developing, perhaps some more western chain stores or movie theaters, are welcome to do so if they find the demand.

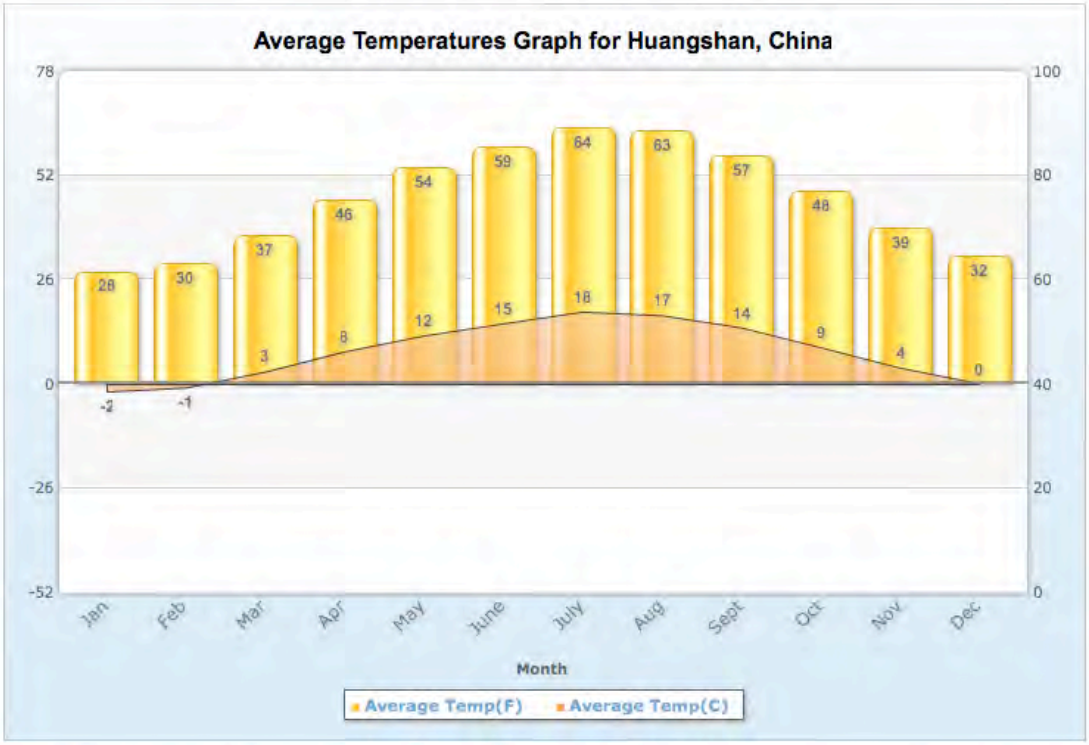
Both natural and man-made restrictions, such as the limited amount of land and the Volume Rate, guarantee preservation of the beauty of Huangshan. Thus, even as it grows in the future, unsustainable urban development, as displayed in cities like Beijing and Shanghai, can be avoided, reinforcing the special natural quality of Huangshan.

3) Possible Strategies for Real Estate Development

Retirement Living

Although there are options for retired living, the district does not yet offer enough medical and entertainment benefits to attract large numbers of elderly. These would need to be developed further, especially higher quality medical facilities. In evaluating the lifestyles and number of people in Huangshan district, the government does not invest enough toward medical facilities for them to meet old-age illness standards. Additionally, the culture of children caring for their parents remains strong in China – giving the elderly less reason to move away for retirement. Those with good health or reliable children nearby most often are Huangshan natives, meaning that their life's salary and current retirement insurance are not high enough for them to afford a new apartment, as real estate continues to develop in the southeast area.

Another factor that presents a challenge for developing real estate for retirement is Huangshan's year-round temperatures. Huangshan has ideal temperatures only four to six months of the year. Huangshan experiences about five months of extreme winter cold. Elderly retirees can be expected to desire a warmer climate unless there are otherwise strong reasons for selecting a destination, such as proximity to family or cultural activities.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
°F	28	30	37	46	54	59	64	63	57	48	39	32
°C	-2	-1	3	8	12	15	18	17	14	9	4	0

Enhancing the Quality of Large Hotels

Increasing quality rather than increasing quantity of large hotels can be a strategy for enhancing the reputation of Huangshan without over expanding hotel space, resulting in low occupancy rates and, as buildings age, poorly maintained hotel stock.

With the understanding that Huangshan district does not have a lot of entertainment, hotel real estate continues development to increase the comfort rather than the length of their customers' stay. Understanding the demand of modernization, hotels have improved from three star facilities to an increasing number of five star hotels, providing air conditioning, hot water, and internet for example. The growth of hotels into resorts, however, is less common and not expected in the near future since the short-term stay of its residents hardly provides enough incentive for the hotel business to invest in resort development. When considering shared ownership of vacation condos or apartments (like the Hilton and Marriott systems), developers do not find Huangshan an ideal location since weeklong and month-long living is best for four months of the year (April and May, October and November).

High Quality/Affordable Living Focused on Residents

Development of Huangshan's real estate market should concentrate on its current residents who live and work year around in the District. Given that local residents have limited income levels, residential housing must be affordable and at the same time should be high quality. Huangshan should consider strategies to maintain housing stock at levels that absorb demand (without excess

demand lowering prices) for new units while at the same time ensuring that local residents have high quality housing.

By using housing policy to ensure a cohesive community, Huangshan not only enhances the cultural life of the region, but it also enhances the overall desirability of Huangshan as a place to live.

5.1.4 Culture, education and entertainment

Huangshan District's culture, education and entertainment profiles

The district's culture is largely based on its tourism industry – the hotels, restaurants and stores all have successfully developed because of the amount of tourists who come to the area to see the mountain. Despite such economic growth, however, the society remains heavily grounded in traditional Chinese culture. Unlike larger westernized cities like Beijing and Shanghai, Huangshan district lacks any traces of McDonalds, Starbucks, or movie theaters.

Though the community lifestyle may not be "western," it is considerably becoming more modern – mostly on a small-scale basis. Spurred by their relatively new living environment, many residents prefer to keep to themselves rather than socialize with neighbors, often resorting to watching television or searching the web. This, however, does not create an unfriendly tone in the community; of 10 households interviewed in the district (from various socioeconomic backgrounds), all said that the community's relations are good but eight of ten admitted that they do not tend to socialize with their neighbors, only stopping to say hello if they pass each other in the street. Large-scale modernization, such as shopping malls, gyms and skyscrapers has yet to develop. Though the district has a library and museum, residents admit they hardly use such facilities, none of the residents interviewed mentioned the library and museum as a form of entertainment.

Urban schools in Huangshan district are considered relatively good in comparison with the rural schools in the nearby areas, causing many farmers wanting to move to the urban district for their children's education. Most convenient is the location of schools near the neighborhoods, at a distance where most parents either send their kids on motorbikes or by walking. The schools have developed advanced classes (for children who show exceptional academic talent) in which students are assigned more work and are expected to score higher in tests. Additionally, lower and middle school curriculum consist of arts and athletic electives like painting, music and Tae Kwon Do.

The entertainment for the district's residents is primarily on its "public field," a neighborhood center where families gather in the evening – for the children to play and the elderly to engage in group dancing. On occasion, the field will even have public viewing of movies. Such space is also ideal for older citizens to gather for taichi in the mornings as their form of daily exercise. Of ten households interviewed, about half mentioned regular visits to the field, for exercise or entertainment, as their daily routine. The residents' committees work with the shequ offices to host annual activities, such as poker tournaments, to enhance community bonding. In addition to the neighborhood center, there are indoor facilities such as a piano room and games center with a ping-pong table for public use.

Development of industry – analysis of the strengths and opportunities

With the development of the southeast side of the city, Huangshan has the space to develop further industry. If they take full advantage of the land area designated to commercial use, industries have the opportunity to grow. Such development should be at a rate fitting to the current residents – one that is not too overwhelming and expensive. And development would also ideally match the growth of the migrant population.

As residential development continues, with the current rate of real estate growth, the area is realistically feasible for more middle-income families or high-income families from larger cities who are interested in second homes. Commercial development could attract such migration and enhance the development of the city. Furthermore, it would not only bring in people who want to live there long term, but it would extend the length of stay for tourists coming to the district to see the mountain. If anything, the current success of the tourism industry that has already caused the economy to grow can catalyze further development.

Opportunities for Education Industry to Expand

Development of higher education could present an opportunity for the city in many ways. It would benefit the construction industry for development of the university and student living accommodation, create demand for commercial development, and renew the youth generation of the district. With the current aging population of Huangshan district's residents, to have more young people both to employ and to move back and care for their parents would greatly add to the city's development.

As Huangshan district's current situation consists largely of a small-town lifestyle and extensive tourist interest, universities must carefully consider when is the best time to carry through with such a substantial investment. It would be most ideal if the creation of a university's second campus in Huangshan also provided higher education for their native students but that would rely on participation of the local government.

5.2 Energy and Environment

5.2.1 Renewable Energy

Huangshan's energy strategy should seek to improve the security of the region's energy resources and sustainable development. To promote a green economy, Huangshan should seek to increase the use of renewable energy, including solar, hydro and biomass, especially wood-based biomass. Opportunities to develop biogas, focusing on the development of intensive farms which relys on the medium-sized biogas projects should also be explored. Solar should include solar PV and solar water heaters.

Renewable energy should focus on the hotel industry, in order to promote the concept of eco-tourism, as well as on industry.

5.2.2 Environment Protection

Huangshan District should concentrate on the following environmental protection initiatives to promote green economy:

Industrial development dimension

Huangshan should strengthen the ecological transformation of traditional industries to develop low consumption and light pollution, high value-added eco-industry. A major part of this will be to develop eco-tourism as well as supporting products and services with ecological characteristics. As we have discussed above, this can include sustainable forestry and agriculture, herbal and traditional medicines, as well as promotion of green consumption. The objective should be higher-value add products that support a clean, low-carbon circular economy. Integration with energy and water systems also be a priority in order to protect natural resources.

Promotion of these industries will require active effort. We recommend the appointment of a task force to identify industries and practices that will support these goals in order to encourage and support their relocation to Huangshan.

Pollution Prevention

Huangshan enjoys a relatively clean envioronment, however that environment is under threat and steps should be taken to proect it. In particular, Huangshan should take steps to address household sewage waste treatment and disposal, as well as waste treatement and disposal of industrial and agricultural production. This should involve the acceleratation of projects for an urban sewage pipe network, and rain sewage diversion pipe network, while speeding up and improving the main and branch network of the industrial parks and expanding the range of park sewage collection pipe system;

It is also essential to improve solid waste disposal facilities. This is essential to protect scenic spots and areas of urban and rural residents. Establishment of the region's integrated pollution prevention and control system and improvement to the urban and rural garbage collection, transportation and processing system are essential. This will involve building the center town garbage collection, and transporting facilities in the supporting regions and to encourage towns to built simple, low consumption sewage treatment facilities.

These facilities should be designed to implement waste collection management, promoting “Waste to Resources”, and to promote Huangshan District Living landfill gas utilization and food waste utilization projects.

Environmental Policy

Huangshan should seek to achieve a higher level of environmental compliance by modernizing its production systems. In order to accomplish this, Huangshan must adopt policies that foster strict environmental compliance, conduct environmental assessments and energy assessments in connection with development projects, and reinvigorate its efforts in environmental protection, soil and water conservation.

The approach can be summarized as the “Three Simultaneous" system. This involves eliminating old technology and production capacity; improving energy conservation statistical monitoring and target assessment systems; and developing the circular economy and effective incentives. This is intended to result in a recycling mode of "Resources - Products - Waste -

Renewable resources", and to use alternative resource conservation, recycling and zero-emission technologies. Towards this goal, the following activities should be explored by Huangshan:

- To promote the combination of circulation type production and industry;
- To improve the comprehensive utilization of resources, reducing pollution emissions from the source origin;
- To take fully advantage of clean development mechanism and contract energy management;
- To promote industrial, construction, public institutions and other energy projects, and the use of energy-efficient and water-saving products appliances;
- To implement strict permit systems and environmental management system certifications;
- To enhance environmental monitoring and warning systems;
- To establish long-term mechanisms to protect water resources, accelerating the Xin'an River basin ecological compensation projects; and
- To strive to establish Qingyi River and the surrounding ecological Huangshan compensation mechanism.

Promoting Public Engagement and education efforts

Huangshan should fully use radio, television, newspapers, Internet and other media, to inform and engage the public. It should promote knowledge of environmental protection in order to guide local residents to build ecological civilization and enhance environmental sustainability awareness. Mobilizing the enthusiasm of the residents in environmental protection initiatives is essential to the region supporting a green consumption economy and these efforts should be linked with promoting local businesses that support the development of a green economy.

Annex 2: A 4-City Study of Sustainability Trends

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Table of Contents

Introduction

This report provides an urbanization overview of four cities in China: Chongqing, Huangshan, Kunming and Shanghai. The report focuses on the following WP4 themes:

a) Socio-economic characteristics: GDP, population, build-up area, urban area vs. suburban area, urban population vs. suburban cities.

b) Environment: water pollution, air pollution, solid waste

c) Natural resources: land, urban greening, fresh water, wetlands

d) Energy use: fossil fuels (coal, oil etc.), clean energy

e) Infrastructure: transportation, water supply facilities, water treatment facilities, housing

f) Social services (soft infrastructure): educational services, medical services, health care services

The purpose of this report is to provide readers with concrete examples of how urbanization is developing in China in these four cities in order to inform the broader analysis of China's urbanization countrywide. We note that these four cities cannot be taken as representative of all of China. All cities are located in the deep south of China, and all of them are south of the Yangtze River. However, they are representative in other ways. Chongqing and Shanghai represent the largest of China's cities, representing metropolitan areas with provincial status. Kunming represents a medium-sized city in terms of population. Huangshan, in contrast, is a rural district, and it has yet to embark on a full program of urbanization. Further, Huangshan represents how the countryside is potentially affected by urbanization in China.

The main method employed is data analysis and processing. During data processing, we follow an indicator system established on WP4 themes. The selected indicators are as following:

a) Society (total population, urban population proportion, number of medical personnel per 10,000 people)

b) Economy (GDP, proportion of primary/secondary/tertiary industry in GDP, fiscal revenues/expenses, unemployment rate)

c) Ecological Environment (volume of water per capita, forest coverage rate, yearly average of atmospheric SO_2/NO_2/PM_{10} concentrations, SO_2/NO_2/soot and dust removal, wastewater treatment capacity, wastewater compliance rate, accumulated sewage treatment amount, sewage treatment plant operating load rate)

d) Energy System (LPG supply, natural gas supply, hydropower station installed/generating capacity, energy consumption amount, energy consumption per capita/per GDP)

e) Infrastructure (urban land proportion in built-up areas, area of paved roads, number of buses/taxies, property prices)

This report is structured in five main sections. Each city is covered in its own section. Within the analysis for each city, we evaluate the WP4 factors cited above in the order presented based on the data available in our indicator system. Following the city analysis, we summarize our general conclusions and the lessons and questions they raise for the broader analysis of Urbanization in China.

In the case of Huangshan, the Renmin University team conducted in depth analysis of the potential path of urbanization. The full case study is presented in Appendix A to this report. Because we conducted deeper analysis in Huangshan, the Huangshan section of this report is based not only on our indicator system, but also on interviews and engagement with the local government.

1 Huangshan[84]

1.1 Introduction

a. Overview

Huangshan District is located inland of South Anhui with Mt. Huangshan to the south, Taiping Lake to the north and Mt. Jiuhua to the west. It covers an area of 1,775 square kilometers with a population of 161,500 (2012). Its history can be traced back to as early as 1,250 years ago. Huangshan District is famous for its unique location, long-standing history, peerless ecological environment and abundant tourism resources.

b. Purpose, Scope and Methods

The purpose of this report is to discover the trends of Huangshan District's recent urbanization and to propose a set of more sustainable strategies for the future by evaluating both the obstacles and potentials of the district.

In this analysis, we evaluate the possible path of urbanization in rural Huangshan District from various perspectives relevant to the WP4 themes, specifically economic, environmental and social factors.

Based on reliable data and first-hand information, we assess the optimal urbanization plans for Huangshan District.

1.2 Huangshan Urbanization Current Situation

a. Society

i. Population

By the end of 2012, the total population of Huangshan District reached 161,500, slightly down from 2011's 162,818. There were 1,452 births in 2012, a birth rate of 8.99‰, and 2,055 deaths, a mortality rate of 12.72‰, making the natural growth rate -3.73‰.

Fig. 1-1 shows the structural changes of population in Huangshan District from 1978 to 2011. Unlike other cities in China, the district didn't witness an explosive increase in total population, however, the proportion of urban population kept rising, possibly indicating a great number of intraregional migrants to the urban area.

Population Proportion

[84] Except where otherwise noted, all Huangshan District data of 2011 and the years before 2011 in this section are cited from *Huangshan District Statistical Yearbook 2012* by Bureau of Statistics of Huangshan District, Huangshan City, and all Huangshan District 2012 data in this section are cited from *Statistical Communiqué of Huangshan District on the 2012 National Economic and Social Development* by Bureau of Statistics of Huangshan District, Huangshan City, 2013.

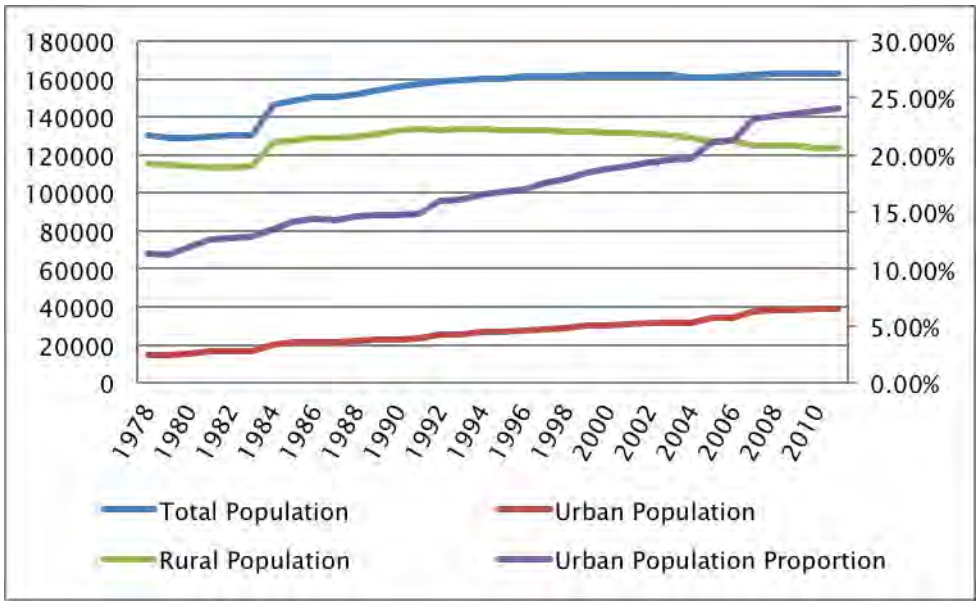


Fig. 1-1 Huangshan District Population Structure (1978-2011)

ii. Culture

In terms of the local culture, residents appreciate the value of family intimacy over the value of material possessions, according to interviews conducted by the Renmin University team with local residents in 2012. From these interviews, we learned that families claimed that they would rather keep the family united in their hometown than send off a child and the mother to a larger city while the father stays at home to work the land. We did of course learn of exceptions, usually wealthy families who have the ability to uproot their lives and move to places with more opportunities. Results are not representative of the entire region, however, as our sample size was small (approximately 15 interviews).

The local culture is heavily influenced by its natural resources and surrounding environment. Surrounded by one of China's most famous tourist-attracting mountain scenic area and producing renowned tea and bamboo items, Huangshan residents focus a lot of their lives on enriching such qualities of their city by developing family-run restaurants, operating hotels or working in bamboo and tea industries.

iii. Health and Hygiene

As of 2012, Huangshan District had 30 health agencies, including 3 hospitals, a center for disease control and a maternity and child care center, with a total of 495 beds. According to 2011's data, the number of medical personnel per 10,000 people of the district was 31, obviously less than the national average of 46[85], implying a comparatively weak local medical system, which is consistent with the fact that the district is still predominantly rural.

b. Economy

i. GDP and Industrial Structure

Of 2012's 6.286 billion RMB GDP, the primary industry in Huangshan District contributed 0.736 billion RMB (with an increase of 4.6% from 2011); the secondary industry generated 2.522 billion RMB(an increase of 14.0%); and the tertiary industry raised 3.028 billion RMB(an increase of 9.1%).

Fig. 1-2 depicts the changes of annual GDP and industrial structure of the district over the past 20 years. In spite of the consistent increase in GDP, the evolution of the industrial structure is more

[85] Except where otherwise noted, all national data in this section are cited from the online national database by National Bureau of Statistics of China (http://data.stats.gov.cn/).

intricate. The tertiary industry proportion had been sharply rising until it reached a peak in 2002 and ever since it has been shrinking while the secondary industry proportion keeps rising. The conversion is possibly due to local government's secondary industry-focused development strategies relying on the abundance of local resources such as bamboo and molybdenum ore, implying that the district is not focused solely on tourism development. However, this can threaten the local environment and erode the sustainability of local development.

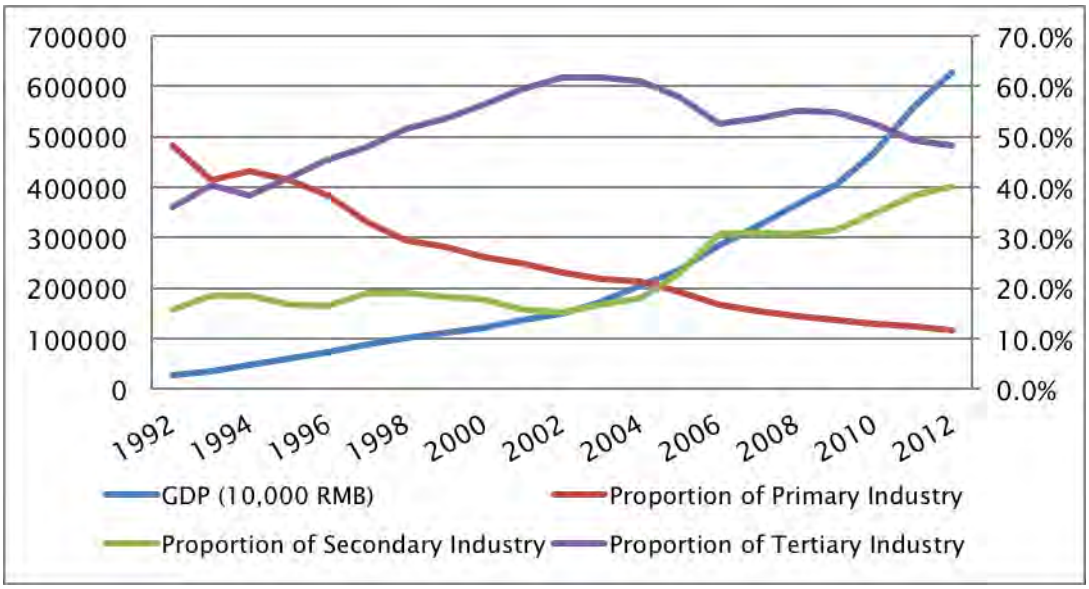


Fig. 1-2 Huangshan District GDP and GDP Structure (1992-2012)

ii. Fiscal Revenues and Expenses

In 2012, Huangshan District's year-end fiscal revenue was 840,070,000 RMB, a 42.3% increase from the year before. Fiscal expenditure was 1,442,000,000 RMB, a 23.0% increase from the year before.

From 2004 to 2012, the fiscal expenses of the district repeatedly exceeded its fiscal revenues, creating an alarming fiscal gap. This situation is partially due to growing demand of infrastructure construction in the district during its ongoing urbanization. How to improve the taxing capacities of local government is one of the essential keys to solve this gap.

iii. Labor and Employment

In 2012, the entire district had 95,828 industrial employees, 2,268 people more than the year before. From 2004 to 2012, primary and secondary industries both saw an overall decrease in employment numbers, whereas tertiary employment remained stable, at a value clearly larger than the other two industries (see **Fig. 1-3**). Considering the rising trend of secondary industry proportion in GDP, it can be deduced that the level of automation in the district's secondary industry was elevated.

The year-end unemployment number of 2011 was 3,991 people, corresponding to an unemployment rate of 3.85%, which was lower than the national average of 4.1%. Hence, the district is not directly faced with a severe unemployment issue.

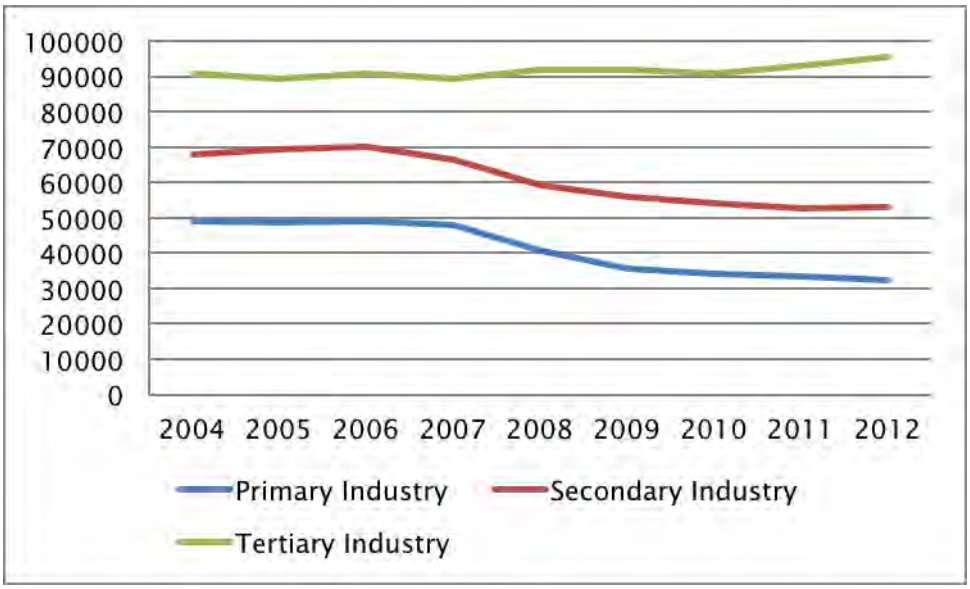


Fig. 1-3 The Changing Trends of the Three Industries' Employment

c. Ecological Environment

i. Natural Resource Endowments

Huangshan District is rich in natural water resources. In 2011, the volume of water within the territory was 10,324.41 m^3 per capita, way beyond the national average of 1,730.20 m^3. There are 25 branches of rivers originated in Mt. Huangshan, which make the richness of both surface water and groundwater in the district.

According to the 2010 survey data on land use change in Huangshan District (shown in **Fig. 1-4**), the total land area was 174.7 million m^2, of which rural land occupied 90.7%; and land used for construction (mainly for residential, industrial and infrastructural purposes) occupied only 6.33%. This situation is coherent with the rustic status of the district. However, considering the mentioned fiscal constraint, it would be unreasonable for the district to practice a more radical urbanization route.

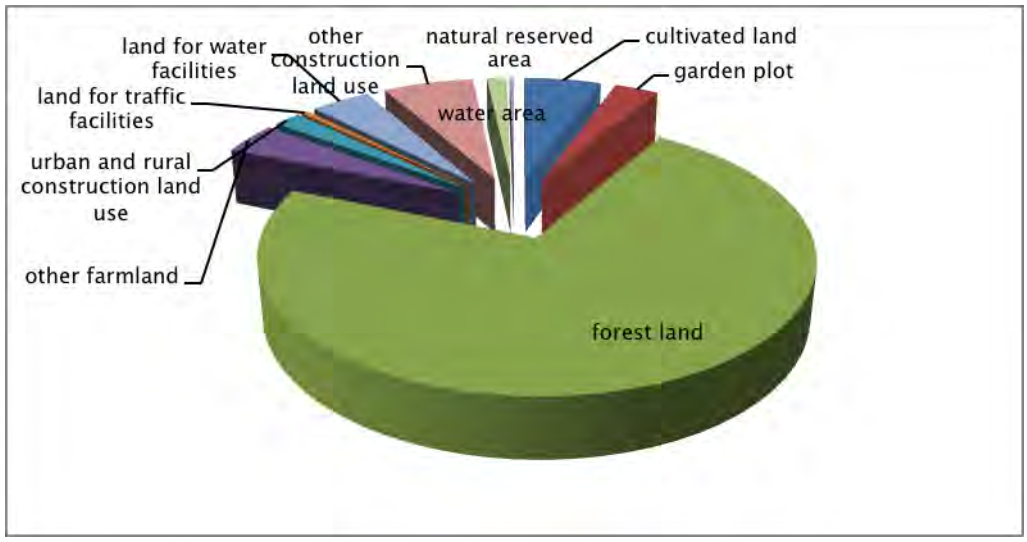


Fig. 1-4 The Current Situation of Land Use in Huangshan District

Huangshan District has an excellent ecological environment. Its natural vegetation is primarily subtropical evergreen broad-leaved vegetation. By the end of 2011, the forest area was 118,133 hectares and the forest coverage rate reached 75.6%, more than 3 times as much as the national

average of 20.4%. The forest coverage rate for the larger Taiping Lake Scenic district was even higher than 95%, as displayed below in **Fig. 1-5**.

Fig. 1-5 The Vegetation Coverage of Huangshan District

ii. Air Quality and Pollution Emissions[86]

In 2011, the yearly average of the SO_2 concentrations on Huangshan's urban air was 0.015 mg/m^3 (while on the national scale, most cities' yearly averages were between 0.020 and 0.060 mg/m^3); the yearly NO_2 concentrations averaged at 0.017 mg/m^3 (0.015~0.040 mg/m^3 on the national scale); and the yearly PM_{10} concentrations averaged at 0.044 mg/m^3 (0.060~0.100 mg/m^3 on the national scale).

Generally, despite its gifted ecological superiority, Huangshan's air quality was not impressively better considering its SO_2 and NO_2 levels, however, it did have a less intractable PM_{10} issue, probably owing to its high forest coverage rate. However, if the secondary industry keeps developing at the current speed, air pollution will become more severe.

iii. Water Quality and Pollution Emissions

Taiping Lake, the largest artificial freshwater lake in Anhui Province, is located in the district and currently the lake's water quality is basically stable in three categories of COD_{Mn}, TN and TP. According to 2008-2011 Taiping Lake Database on water quality monitoring, Taiping Lake water remains at Class 3 standard by the National Surface Water Quality Standards (GB3838-2002).

In 2011, the urban water source quality of Huangshan District was fairly good, reaching Grade B protection levels for its water quality requirements. The rural 10 categories for surface water quality became steady, with excellent water quality, reaching Grade A protection levels for its water quality requirements. Solid Waste Generation

The source of solid waste in Huangshan District is primarily from industrial, agricultural and residential production. Industrial sites send solid waste to disposal concentration sites, then ultimately the waste goes to a landfill; from agricultural production, the use of agricultural film (plastic film?... please clarify) as well as chemical fertilizers and pesticides has become a major source of solid waste; most towns' residential households' waste is collected centrally and then transported to the district's landfill for processing.

iv. Environmental Pollution Control Facilities and Emissions

[86] The national data in the following paragraph are cited from *2011 Reports on the State of the Environment in China* by Ministry of Environmental Protection of PRC.

The years of 2011 and 2012 have witnessed positive changes in Huangshan District's treatment of industrial atmospheric waste pollutants, for the removals of SO_2 and NO_X have started to rise (especially a sharp rise for SO_2 removal) in spite of a slight decline in the amount of soot/dust removal (see **Fig. 1-6**). The *Plan for Environmental Protection of Huangshan City during the 12th Five-Year Plan Period,* which includes stricter regulations on such emissions, is thus having, most likely, a significant impact.. Moreover, increased fiscal expenditure on environment protection has made a contribution as well.

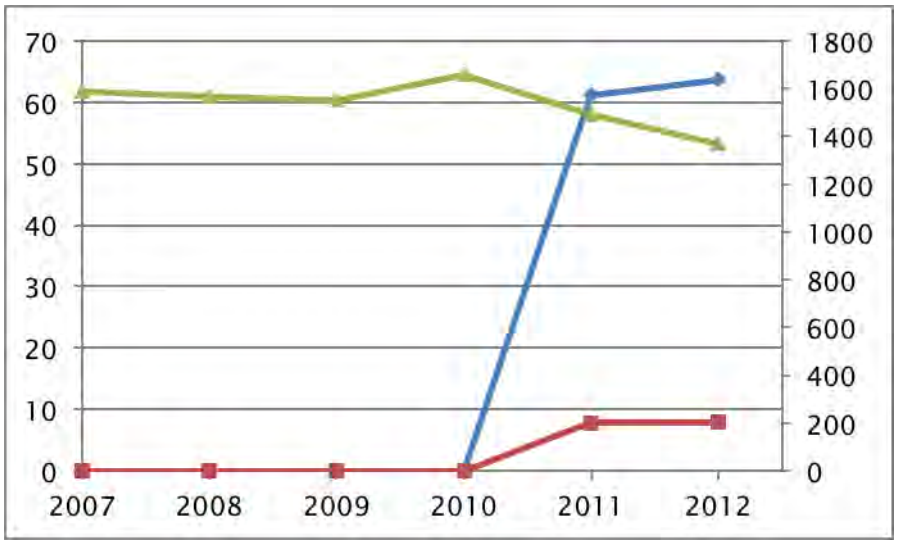


Fig. 1-6 Huangshan District's Industrial Atmospheric Waste Pollutant Treatment

Considering Huangshan District's industrial wastewater pollutant treatment during recent years, there is an ever-increasing trend of wastewater treatment capacity, from 1,200 tons in 2007 to 2,015 tons in 2010 (a number which has been maintained for the past three years), with wastewater compliance rate remaining at 100% (see **Fig. 1-7**). Nevertheless, if the amount of wastewater emission continues to increase, then the district will face new challenges on further elevating its treatment capacity to maintain the 100% compliance rate.

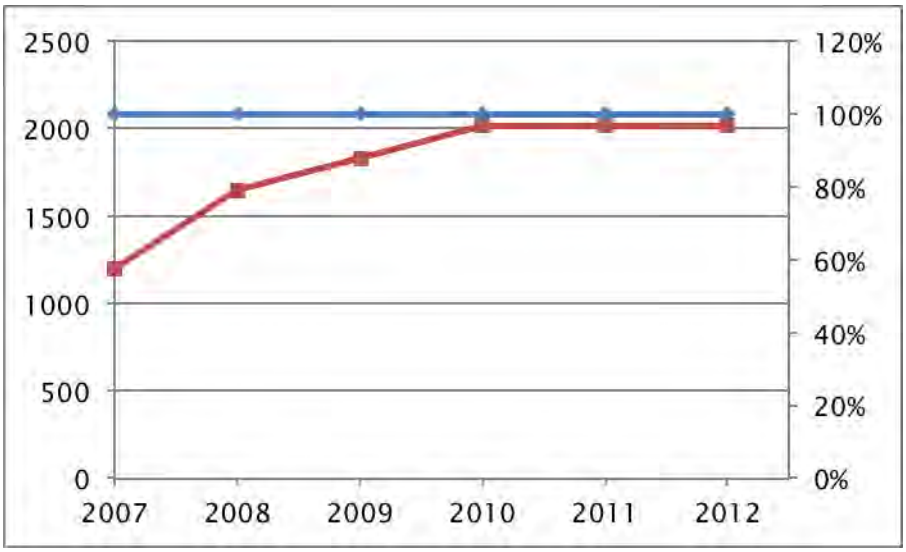
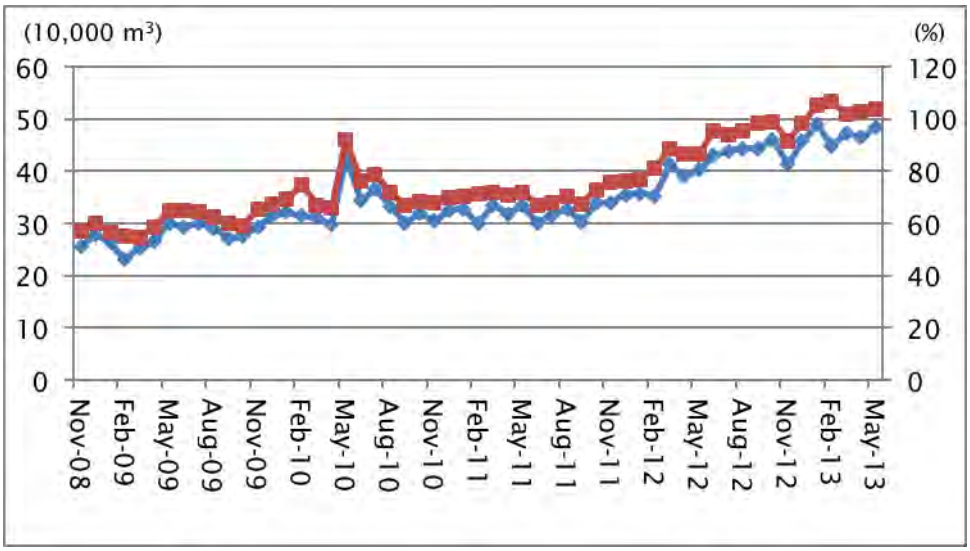


Fig. 1-7 Huangshan District's Wastewater Pollutant Treatment

In recent years, Huangshan District's sewage treatment plant's treatment of residential sewage shows that accumulated treatment and the operating load rate are both increasing nonstop — from 256,000 m^3 and 56.89% respectively in November 2008 to 482,900 m^3 and 103.85% in May 2013 (see **Fig. 1-8**). An alarming sign is easy to detect that the operating load rate has been rising above 100%, which can also been perceived as a direct result of the expanding of urbanization. To enlarge the operation capacity is in urgent need.



Accumulated Treatment Amount (10,000 m^3) / Operating Load Rate (%)

Fig. 1-8 Operation Data of Huangshan District's Sewage Treatment Plant

d. Energy Systems

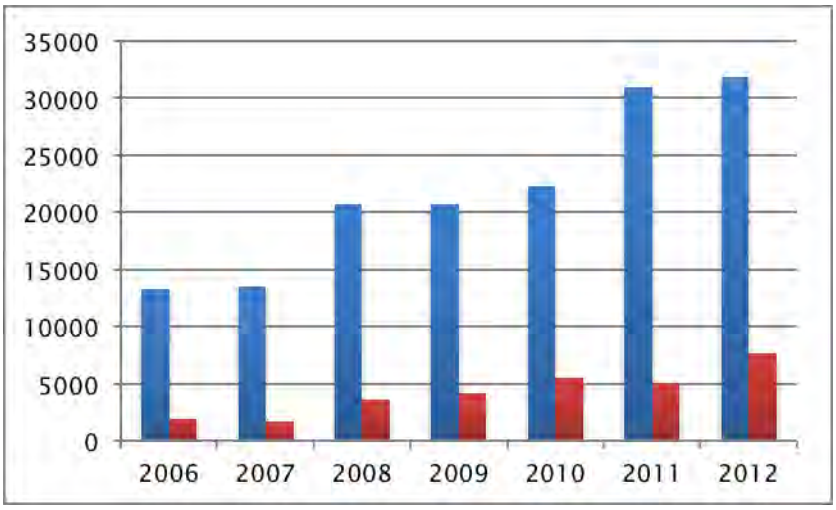
i. Fossil Fuel Energy Supply

Huangshan District lacks natural fossil fuel energy resources, without any oil and natural gas resources and only a small amount of coal deposits. Currently, the coal used in the district is all imported from outside the city, often even from outside the province. Sinopec, PetroChina, and public refueling points are the primary providers of refined oil. In terms of liquefied petroleum gas (LPG) and natural gas, sales of LPG are mostly made by canned supply, with a few amount supplied by pipeline. Currently the supply is 1,200 tons per year to 3 neighborhoods, with 5 kilometers of pipeline and 12 gas supply websites.[87] Huangshan District's natural gas supply is mostly dependent on the agreement of Hong Kong-China natural gas, and the district started construction of the natural gas pipeline web in 2009.. In 2012, the amount of natural gas supplied for residential, business and industrial use was about 1,670 m^3, 12,040 m^3 and 3,655,300 m^3 respectively.[88]

ii. Renewable Energy Supply

In terms of renewable energy, Huangshan District is rich in water resources and the exploitation of local hydropower has developed fairly quickly. Currently, there are already 30 hydropower stations constructed, supplying an aggregated volume of 31,820 kilowatts in 2012 and generating capacity of nearly 77 million kilowatt hours, a difference of 1.4 and 3 times the respective values of 2006 (see **Fig. 1-9**).89 However, the potential ecological threats of hydropower exploitation should be taken into consideration by the local government and hence a careful cost-benefit assessment is required for new hydropower projects.

[87] Source: Deep Source Gas Company.
[88] Source: Hong Kong-China Gas Company.
[89] Source: The Water Conservancy Bureau of Huangshan District (by interview).



Installed Capacity (kilowatts) / Generating Capacity (10,000 kwh)

Fig. 1-9 Installed and Generating Capacities of Huangshan District's Hydropower Stations (2006-2012)

In terms of agricultural bio-energy, with the support of both national and local governments, the district has created programs for using livestock manure for biogas supply, which has been provided to 6,000 people and 40 mid-sized farms. However, the follow-up management investment of both manpower and finance is not enough and the farmers' awareness on both the economic and environmental benefits of bio-energy remains fairly poor.

In terms of solar energy use, Huangshan District is rich in solar resources. In the thirty years between 1971 and 2000, the yearly average of sunlight was 1,648 hours, making it a "very rich" resource.[90] As for making use of the rich sunlight resources, the district's residents often use solar panels to heat their water.

iii. Energy Consumption

Huangshan District's energy consumption has grown fairly quickly, with 201,300 tons of coal equivalent consumed in 2012, twice the amount consumed in 2005 (see **Fig. 1-10**). Under the eleventh five-year plan, yearly average energy consumption growth reached 7.9%, a higher value than the country-wide average growth value of 6.6%[91]. The value for 2012 was greater than 2011 by 8.1%, suggesting the district's high-speed development during recent years and corresponding to the ongoing urbanization and industrialization process. Simultaneously, this trend adds to the environmental pressure on the district as well, considering coal is still the main energy source.

[90] Source: Ibid. The country's determination of sunlight abundance is split in the following categories: extremely rich, very rich, rich or ordinary.
[91] Source: http://jingji.cntv.cn/20110311/104499.shtml.

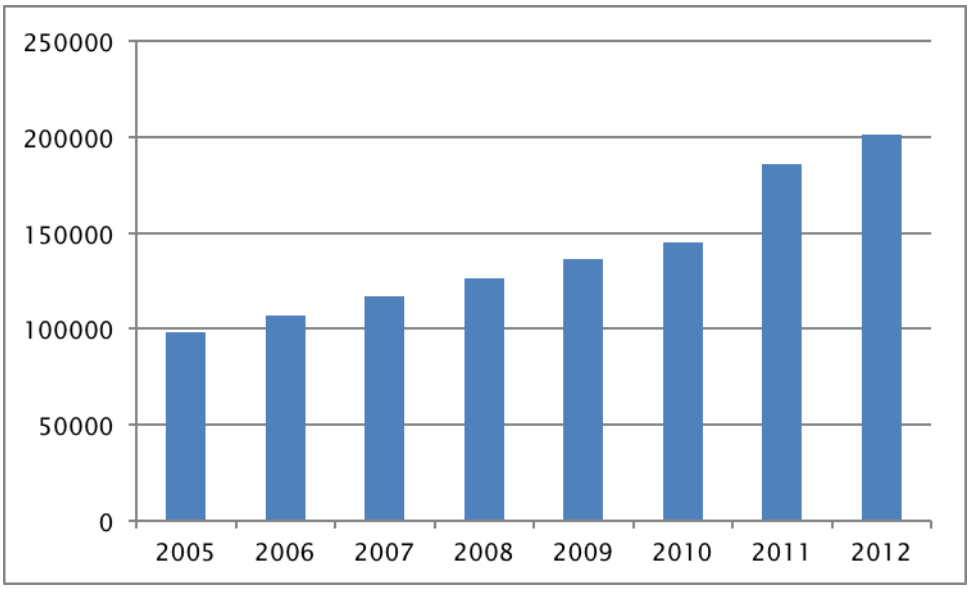


Fig. 1-10 Huangshan District's Energy Consumption Amount (tons, 2005-2012)

Comparing with the country's average level, Huangshan District's energy consumptions per capita and per GDP are both low (see **Fig. 1-11**). In 2011, the district's energy consumption per capita energy was 1,143 kg of coal equivalent (national average: 2,366 kg) and energy consumption per GDP was 333.53 kg of coal equivalent per 10,000 RMB (national average: 700.33 kg of coal equivalent per 10,000 RMB[92]). The comparison indicates that the district is on its primary stage of urbanization development with a relatively small scale of energy consumption in spite of the current increasing trend and a relatively low level of energy efficiency. However, if the local government can make a set of forward-looking energy strategies focusing on elevating energy efficiency and utilizing renewable energies, the district will possibly grasp an opportunity to be sustainably urbanized in the future.

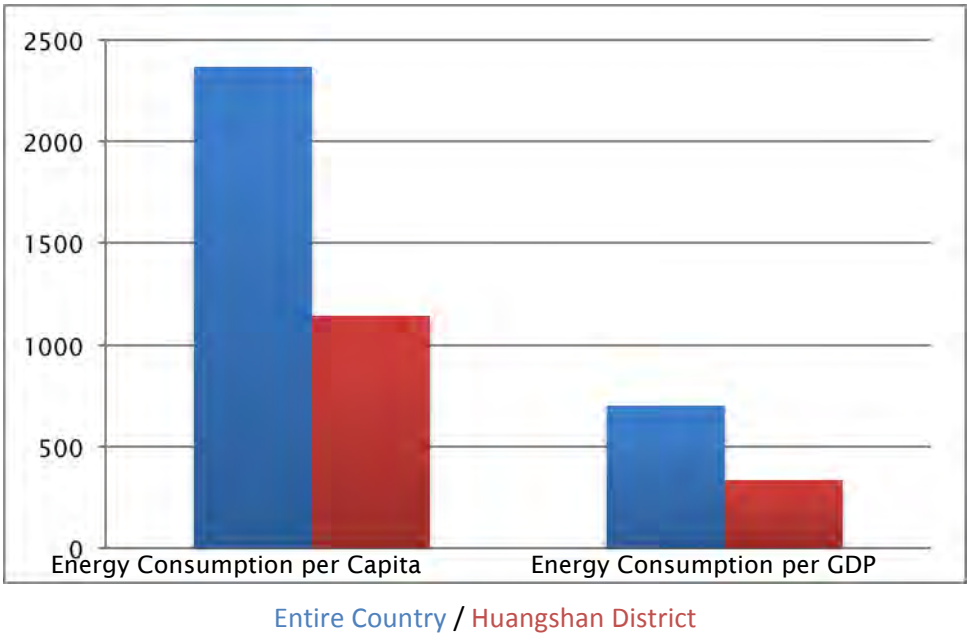


Fig. 1-11 Huangshan District and China's Energy Consumptions per Capita and per GDP (2011)

e. Infrastructure

[92] National data in this paragraph are cited from *China's Energy Statistical Yearbook 2012* by National Bureau of Statistics of China.

i. Built-Up Area Status

The 2010 survey data of land use change in Huangshan District on **Fig. 1-12** below shows how the built-up land is split for natural and industrial purposes. By the end of 2010, the total built-up area of the district was 8 km^2, which had grown from 4.5 km^2 during the years of 2002-2006. The additional 3.5 km^2 is now called "New District", southeast of the old part of the city. Since urban land only took up 5% while rural residential land took up 29%, Huangshan District has just embarked on urbanization.

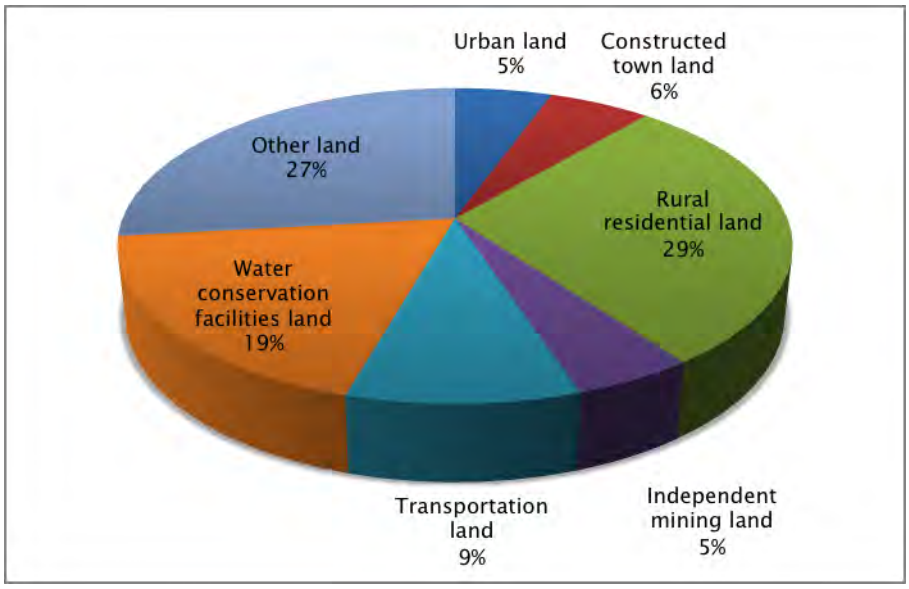


Fig. 1-12 Built-up Land Use of Huangshan District

ii. Road Conditions

From 2002 to 2011, Huangshan District's area of paved roads increased by more than 250%, from 249,200 m^2 to 910,000 m^2. Although there have been minor traffic jams emerging in the district recently, the number of cars is still not significant enough for the city to build parking lots at shopping centers, etc. People are used to park cars along the sides of the road. However, with the development of the new southeast area of Huangshan District, many buildings are spread apart and the roads are noticeably wider, hence an increase in vehicle density in the future is predicted.

iii. Local Transportation

In Huangshan District, there are no surface or underground railways. The main form of public transportation within the district is by bus or taxi. As of 2011, there were 40 buses and 47 taxis registered in the area. The district database indicates that the number of buses has increased from 30 in 2004 while the number of taxis has always remained below 50.

Most local residents work near their homes and therefore do not rely heavily on transportation. For those who do not commute on foot, motorcycle is often convenient enough.

iv. Intercity and International Transportation

Given the relatively rural and small size of Huangshan District, all forms of intercity and international transportation depend on the larger Huangshan City and the nearby larger district, Tunxi. Huangshan City has an airport located in the Tunxi District, with flights to Beijing, Chendu, Guangzhou, Hefei, Shanghai, Shenzhen and Chongqing. The only international transportation that the city offers is by plane to Seoul, South Korea.

The most popular form of transportation for long-distance intercity travel would be by train, with Beijing, Shanghai, Guangzhou, Nanjing, Hefei, Jingdezhen, Nanchang, Xiamen and Fuzhou as

destinations. The railway station is set in Tunxi District's downtown area. (However, no materials currently available showing trends on this issue.)

v. Residential

The earliest new neighborhood in the district was constructed between 1997 and 2000 and the community was completed around 2001. By law, only people with urban status citizenship are permitted to buy houses in the city. Many families of multiple generations, therefore, are squeezed under one roof. For a 70 m^2 space, it is not unusual for three or four people living within two bedrooms and two living rooms.

Many people would like to move to larger homes but report that they can no longer afford the rising cost of housing. The newly developed houses in the "New Area" are priced on average 3,580 RMB/m^2, which would take an average Huangshan lower-middle class citizen 8 years to pay off a 96-m^2 apartment, and only if they dedicated their entire salary to the cost of the house and nothing else. It can be detected that the district is faced with a deficiency of housing and the situation hence pushes up the property prices, which would negatively influence its urbanization. Therefore, local government needs to consider constructing more houses but meanwhile to avoid irrational urban sprawling.

1.3 Analysis and Conclusion

1.3.1 Analysis of Core Issues of Huangshan Urbanization

a. Existing Issues of Economic Development

i. Industrial Structure

Considering the structure of Huangshan District's GDP, from 2000 to 2012, the primary industry had been falling (from 26.2% to 11.4%) while the secondary industry's share had been rising dramatically (from 17.6% to 40.1%) with the tertiary industry's proportion declining slightly. This conversion is partially due to its accelerated urbanization during recent years which has leaded to shrunken farmland and reduced labor force of farming. Meanwhile, local government intends to develop the secondary industry to boom local economy by other means than its traditional tourism-dominant tertiary industry. However, the expansion of secondary industry is very likely to harm local environment and hence undermine the revenue generation capacity of tourism. Without stringent environmental regulations, chances are that the overall economy of the district will be stagnant in the future and that the local urbanization is unsustainable.

ii. Government Financial Conditions

In 2012, Huangshan District's financial expenses reached 1,442 billion RMB, with an increasing rate of 26.5% from the previous year. There appears to be various reasons for the district's financial deficit mentioned above, including a lack of stable growth of income sources (due to poor economic planning and irrational industrial structure) and numerous newly introduced policies with incremental expenditure (such as the wage increase of civil servants).

b. Existing Issues of Ecological and Environmental Protection

i. The Safety Issue of Drinking Water

Huangshan No.1 Water Plant is the main source of drinking water for Huangshan District, serving for both urban and rural areas. It is located on Puxi River in Gantang Town in the district. Zhanggeng Village, located upstream of the water intake, has a large number of farmers with an inefficient pattern of farming using excessive amounts of pesticides and fertilizers, which has become a great threat to the safety of the drinking water sources. Besides, the residential sewage along the river has also become a major source of drinking water pollution.

ii. Environmental Threats of Tourism Development

In recent years, Huangshan District's tourism industry has experienced rapid development. However, this development combined with a lack of overall planning and environmental protection has had a rather negative impact on Huangshan District's environmental carrying capacity. Massive large-scale construction projects will reduce the conserved forest area, change the original ecological environment and destroy the ecosystem's integrity. Otherwise, reception of excessive visitors will result in increased resource consumption and waste emission, further threatening the environment of Huangshan District.

iii. Environmental Threats of Secondary Industry

Since the Eleventh Five-Year Plan, the secondary industry in Huangshan District has been gaining momentum. Industrial parks have appeared and gradually evolved in both area and technology, and industrial output has grown at an accelerating rate. An increasing proportion of secondary industry in the local economy includes printing, copper processing, non-ferrous metal smelting, etc. It should be realized that enterprises engaged in heavy metals, molybdenum smelting, molybdenum chemical, etc. are prone to large-scale environmental accidents, not to mention their routine pollution emission.

c. Existing Issues of Social Development

i. Loss of Human Capital

It is not difficult to get a job in Huangshan District, nevertheless, a well-paid one is rare to find. Lacking large- and medium-sized enterprises, Huangshan does not have a prosperous job market, even though the local unemployment rate of 3.82% was lower than the national average of 4.1% in 2012. With real estate prices increasing, low-income people are living under more pressure than ever before. If this situation continues, Huangshan District will face enormous loss in human resources, for all levels of labor force are likely to move away.

ii. Education: Improved but Not Perfect

Education is improved in Huangshan District but still not perfect. Since Huangshan is a county-level city, K-12 education resource is relatively equally distributed there. However, the number of students per class is often between 50 and 60, making it very hard for teachers to provide each student with sufficient attention at school. Additionally, afterschool programs are not as diversified and qualified as what their counterparts enjoy in large cities, which possibly means teenagers there lack opportunities to develop various talents.

iii. Wealth Gap

In 2012, the annual net income per capita of farmers in the district was 9,426 RMB, while disposable income of urban residents reached 20,346 RMB, more than twice the former. Unsurprisingly, such wealth discrepancy is partially rooted in differentiated education and family background. Those young people who were privileged enough to attend college in nearby cities and find jobs in Shanghai, for example, can move back to Huangshan having accumulated much more wealth than a high school drop-out farmer boy who is trying to create a better life for himself by moving there too.

d. Existing Issues in Sustainable Energy

The local government of Huangshan District has not yet come up with any specific development or management plan for renewable energy. Additionally, for the local people, the awareness of the economic and environmental benefits of renewable energy is not high enough. Local energy has not been fully exploited, especially the potential for utilization of biomass energy.

Currently, the main energy source in Huangshan District is coal and other kinds of fossil fuel energy, even though such energy resources are scarce in the district. This makes the district heavily reliant on external energy supply in an unsustainable way. On the other hand, the district is endowed with abundant renewable energy such as hydropower, agricultural bioenergy, forestry

bioenergy and solar energy. If these renewable energy resources are to be efficiently exploited, then the district is very likely to save on energy consumption as well as embrace a more harmonious and sustainable environment.

1.3.2 Sustainable Strategies for Huangshan Urbanization

a. Economic Development

i. Tourism Industry

- Product Diversification

Tourism market evolution requires both fully exploring the potential of existing market and developing new tourism market products. Diversified marketable tourism products are crucial in further development of tourism market. Specifically for Huangshan District, it is important to explore innovative material and service products based on the splendid history and culture of the district.

- Infrastructure Development

Municipal infrastructures are essential for a tourism-centered district, for they have to support both local residents and massive inflows of tourists at the same time. In order to further develop tourism, Huangshan District should focus on the construction of roads, parks, communication networks, etc. However, attention should be paid to the financial deficit of the district and potential ecological impacts before any new construction project.

- Ecotourism Development

Focusing on environmental-friendly tourism/low-carbon tourism/ecotourism presents a possible opportunity for Huangshan District to preserve its environment and culture as well as make profits from tourism. Making Huangshan an ecotourism destination may attract visitors for its unspoiled natural beauty and sustainable development ideology.

ii. Agriculture

- Ecological Priority

Huangshan District's agricultural development must emphasize the principle of "Ecological Priority" in order to accelerate the transformation from unsustainable agriculture to environmental-friendly agriculture. If excessive fertilizers and pesticides are used by farmers who are unaware of the consequential ecological harm, not only will health hazards be brought by the agricultural products, but also the farmland will be damaged and unable to make qualified output in the future. Such unsustainable agriculture will eventually impair the farmers' benefits.

- Brand Strategy

Thanks to its superior natural endowment, Huangshan District is able to develop diversified and qualified agriculture including conventional crops, tea, bamboo, etc. If these agricultural products are promoted with elements of Huangshan Districts' unique culture and ecology with brand strategies, the market is very likely to be extended.

b. Energy and Environment

i. Renewable Energy

- Combination with Ecotourism

As a tourism-based area, it is essential that Huangshan District should develop renewable energy via tourism. As mentioned above, ecotourism can be a feasible path for further development of the district's tourism. Hence, it is reasonable to combine renewable energy policies with ecotourism strategies. For example, solar water heaters should be popularized among all hotels in the district.

- Bio-Energy Development

Since Huangshan District is endowed with abundant ecological resources, various kinds of bio-energy are available including wood-based biomass, livestock manure biogas, etc. Livestock manure biogas should be further generalized in local farms as part of a circular economy. Meanwhile, wood-based biomass can be used to generate heat for local residents in Winter. However, to raise people's awareness of both the economic and ecological benefits of bio-energy and to adopt innovative technologies are vital in popularizing bio-energy development.

ii. Environment Protection

- Pollution Prevention

Huangshan District enjoys a relatively clean environment, however, the environment is currently under threats as local economy flourishes, especially when the proportion of secondary industry in local GDP keeps increasing. Hence, steps should be taken to prevent excessive pollution. In particular, the district should accelerate the project for a developed urban sewage pipe network and water treatment facilities, and meanwhile enhance the monitoring and regulating capacities of pollution emission from local factories. It is also essential to improve solid waste disposal facilities, which is essential to protect scenic spots. Additionally, more stringent environmental standards are anticipated.

- Combination with Ecotourism

Since tourism is Huangshan District's pillar industry, environment protection will not likely to directly restrict its economic development, for deteriorated ecology will harm tourism and trigger severe problem in local economy. Under such circumstances, as mentioned, ecotourism is possibly a wise choice for the district. If environment protection is well combined with incentives to further develop tourism, then the outcome is sure to be more effective.

- Public Education and Engagement

Huangshan District should fully use radio, television, newspapers, Internet and other media to inform the public about environmental facts and to collect residents' opinions. Local government should also spread the knowledge of, and the need for, environmental protection to the people in general, so as to guide local residents and raise awareness of ecological civilization and sustainable development.

2 Shanghai

2.1 Introduction

a. Overview

Shanghai sits at the mouth of the Yangtze River, the longest river in China. It borders the estuary of Yangtze River to the north, Jiangsu and Zhejiang Provinces to the west and Hangzhou Bay to the south. Due to its advantageous geographical location, Shanghai has become a large and prosperous port city. It is the largest Chinese city and "a city of skyscrapers". With a history of more than 700 years, Shanghai was once the financial center of the Far East. Today, Shanghai is the largest economic and transportation center in China. Shanghai also has one of the world's busiest ports, and has become the largest cargo port in the world. The municipal government is working towards building Shanghai into a modern metropolis and into a world economic, financial, trading and shipping center.

b. purpose/scope/methods

Shanghai's recent urbanization process begins at the end of the 1970s, when the population was less than 10 million. After more than 30 years of development, Shanghai has already completed its urbanization process. As a pioneer of China's urbanization, Shanghai's urbanization process may? greatly influence other cities' urbanization. Therefore, focusing on the WP4 themes, this section analyzes Shanghai's urbanization trends to reveal its policy implications and possibly serve as a model for other large cities.

2.2 Shanghai Urbanization - Current Situation

a. Society

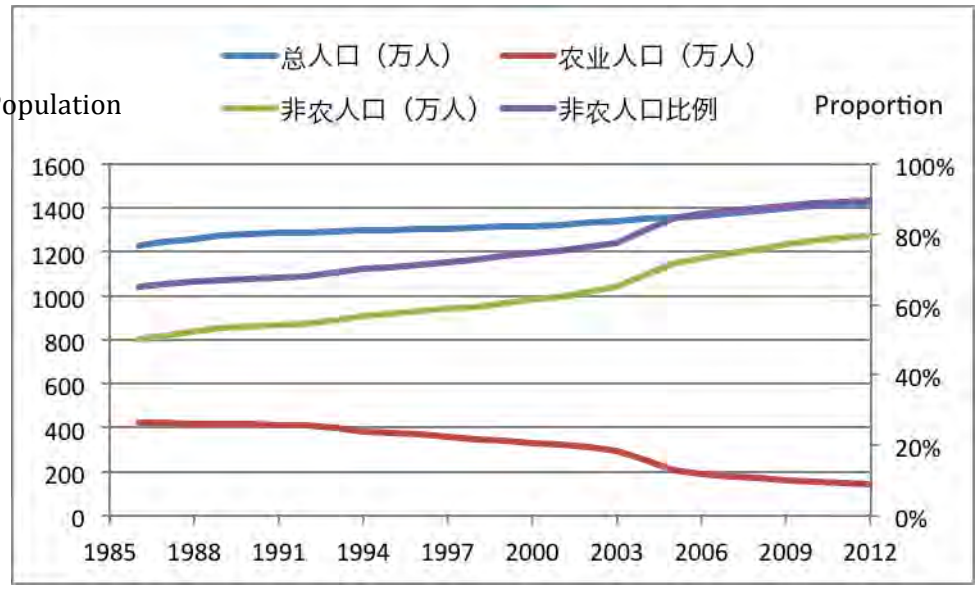
Population

Along its process of urbanization, Shanghai's birth rate declined, which is similar to what happened on other developed countries or cities. Since 1993, Shanghai's natural growth rate has been negative, which has resulted in a population decline and a large elderly population. Benefiting from a small birth peek in 2012 and the two-child policy (If both spouses are only child of their family, they can have two children), the population growth rate returned to positive in 2012.

Shanghai is unusual for a mainland Chinese city, not only because it has a negative birth rate, but this is probably due to the nature of its urban population. People of child bearing age are probably working professionals who are deferring child birth or foregoing it for economic or lifestyle reasons.

By the end of 2012, the total population of Shanghai district was 14.27 million people, including 12.80 million urban residents and 1.46 million rural residents. There were 121,100 births in 2012, a birth rate of 8.51%. There were 117,400 deaths, or a mortality rate of 8.25%. The natural growth rate was 0.26%. Fig. 2-1 shows the population changes in Shanghai over 26 years.

According to the statistics, Shanghai District's urbanization developed very early, the proportion of urban population in 1986 was already over 65%, which became nearly 90% in 2012. Meanwhile, the urban population of China only accounts for 52.6% of the total population. 37.4% lower than Shanghai.



Total Population / Rural Population / Urban Population / Urban Population Proportion

Fig. 2-1 Shanghai District 1986-2012 Population Structure

i. Education

At the end of 2011, there were 66 colleges and universities in Shanghai, accounting for 2.7% of total colleges and universities in China. University level enrollment was 511.3 thousand students. Shanghai has 1,728 schools in total, with 147.1 thousand teachers and 1.99 million students.

The ratio of students and teachers was 15.81 in primary school, less than the national average level. The ratio of students to teachers at high school level was 9.7, again less than the national average level. The ratio of students and teachers at colleges and universities was 16.92, less than the national average. Thus, Shanghai's educational resources are above average for China.

Shanghai is able to attract and maintain a larger number of teachers because Shanghai is both a desirable place to live and it can afford to pay higher salaries. The average salary for a university/high school level instructor is 83074 RMB/year, compared to the national average of 47734 RMB/year.

The figure 2-2 below shows the number of all kinds of educational institutions.

The figure 2-3 shows the comparison of Student-Teacher Ratio by Level of Regular in Shanghai and China.

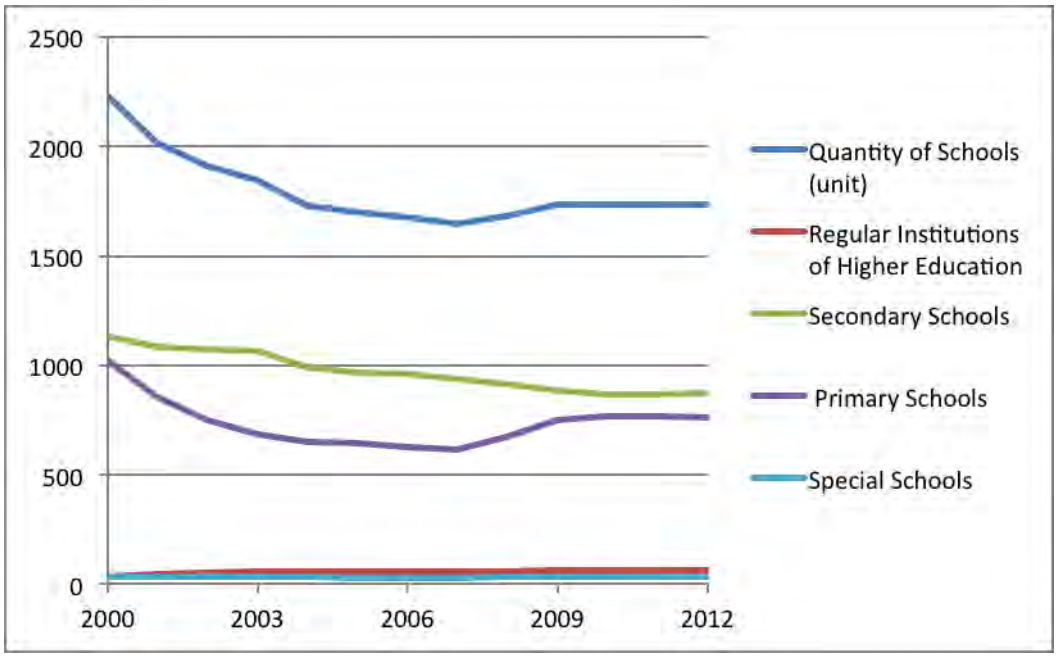


Fig. 2-2 Number of schools in Shanghai

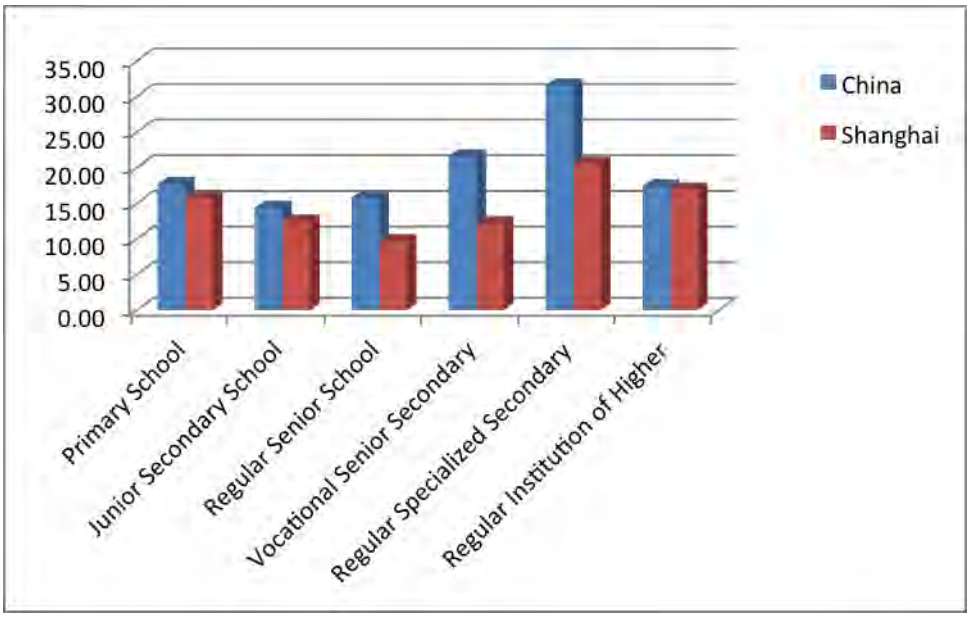


Fig. 2-3 Student-Teacher Ratio by Level of Regular

ii. Culture

Since the 1990s, Shanghai has built a lot of cultural entertainment places, including Shanghai museum, Shanghai library, Shanghai grand theatre, Shanghai bookstore, Shanghai urban planning exhibition hall, Shanghai science and technology museum, the Oriental art center, the east green boat etc.

By the end of 2012, there were 27 municipal, district (county) public art galleries, 138 art performing groups, 25 public libraries and 109 museums. By the end of 2011, The total number of public library books was 68.93 million, increased by 25.3% from 2000. The number of books for every one hundred people was 485.65, increased by 16.7% from 2000. While Chinese total public library books was 697.19 million, Shanghai accounted for 9.89%; and the number of books for every one hundred people in China was 51.7, 89% less than Shanghai's average level.

Financial resources and planning have contributed to make Shanghai a cultural center. Promotion of the arts and museums has been a priority in order to ensure that Shanghai's reputation as a cultural center matches its reputation as a business center.
The figure 2-4 shows that the number of theatres decreased from 2003 to 2010, and then increased from 2010 to 2012. The figure 2-5 shows the number of public library books.

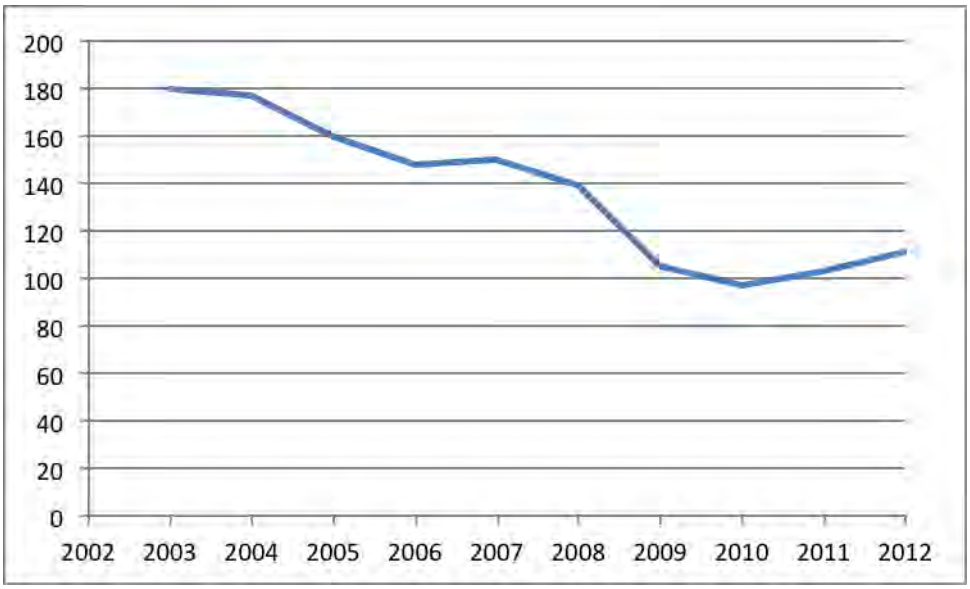


Fig. 2-4 Number of theatres in Shanghai

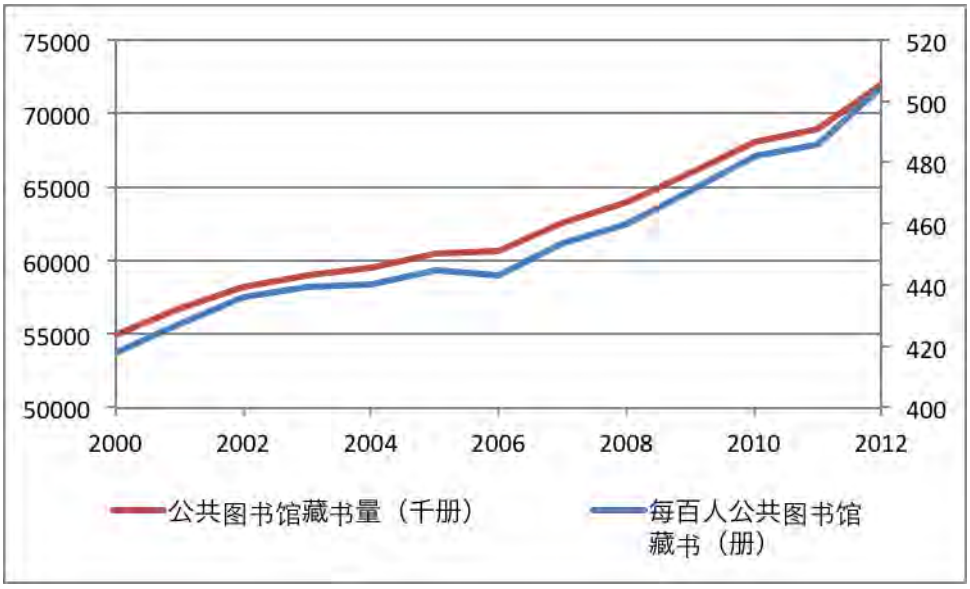


Fig. 2-5 The number of public library books

iii. Health and Hygiene

By the end of 2012, Shanghai district had 3,465 health care institutions, including 317 formal hospitals, with a total of 54.2 thousand doctors and 109.6 thousand beds. While Beijing had 9,974 health care institutions until 2012, twice more than Shanghai, including 608 hospitals and 54,89 thousand doctors and 92.61 thousand beds. Shanghai's health workers per thousand people was 9.92, while Beijing was 14.2, national average was 4.58.

Shanghai's medical resources are better than in most other cities in China. But regardless of the number of health institutions, Shanghai cannot compare to Beijing. The main reason is that the distribution of China's medical resources is not compatible with the status of local economies, but with political concerns. Both Beijing and Shanghai are municipalities and the population densities are rather high, so the medical resources of them are generally abundant. However, since Beijing is the capital and the political center of China, more medical resources are allocated to Beijing than Shanghai.

Since 2010, Shanghai's village clinics in Suburbs and community health service center gradually realized the real-time medical reimbursement. The figure 2-6 shows the number of health care

institutions and hospitals. The figure 2-7 shows the number of doctors and beds, and figure 2-8 shows the number of doctors per 10,000 people.

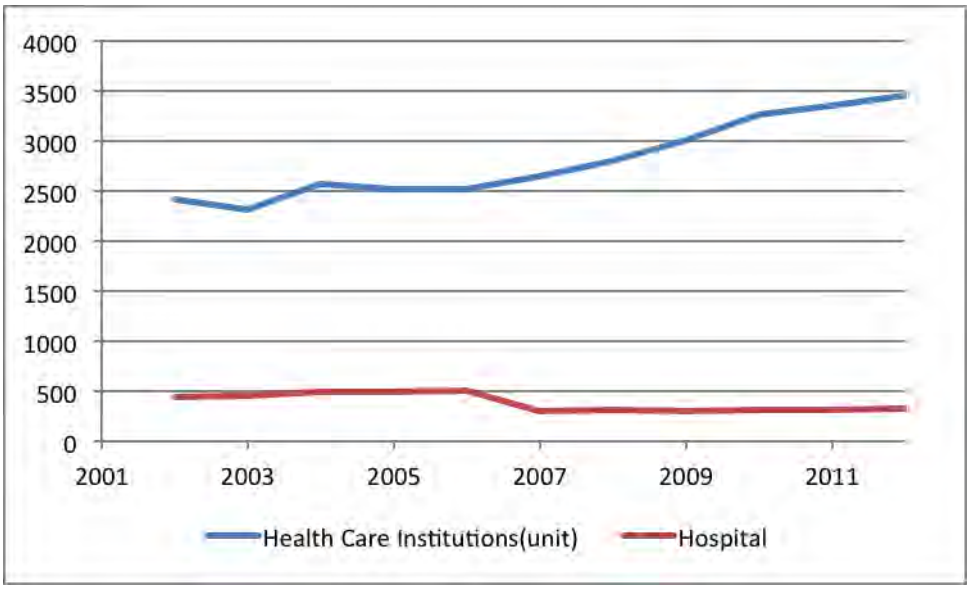


Fig. 2-6 The number of health care institutions and hospitals

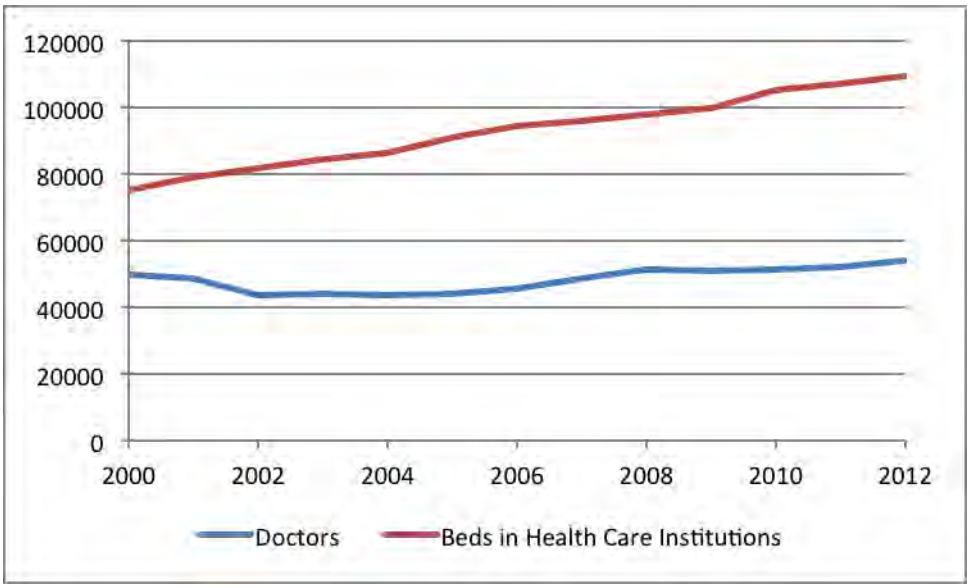


Fig. 2-7 The number of doctors and beds

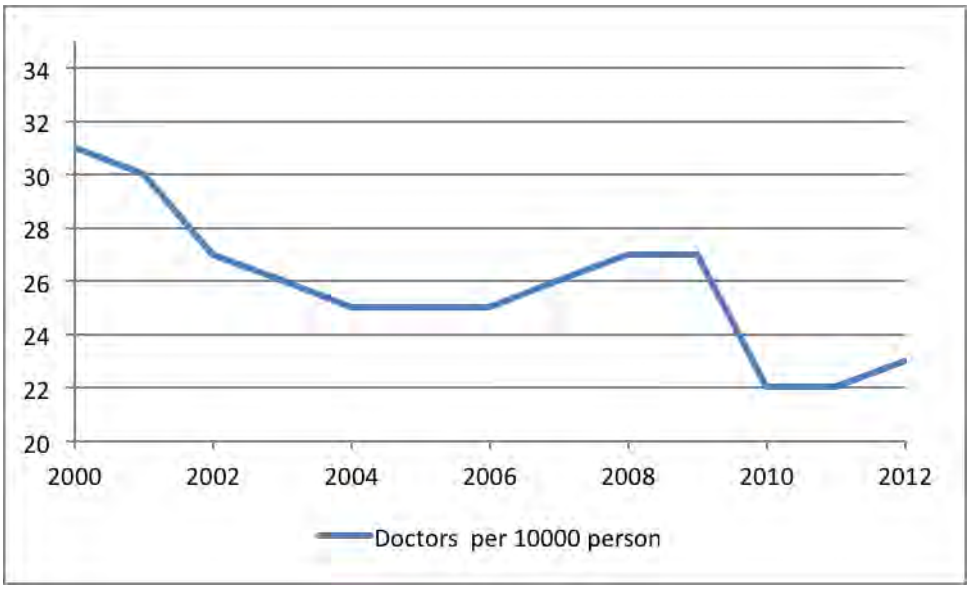


Fig. 2-8 Doctors per 10000 people

iv. Social insurance and social assistance

In the year 2012, 13.26 million people had participated in urban basic old-age insurance, accounting for 93.0% of the total population, while the national participation rate was about 25%. And 6.17 million people had participated in unemployment insurance in Shanghai (43.2% of total, three times more than the national participation rate), 13.76 million people had participated in basic medical insurance (96.4% of total, while national level was about 40%). These statistics illustrates that the social insurance system in Shanghai is relatively developed.

With Shanghai's development, people's life quality improved. People in Shanghai need better social security provided by government, which was a driving force for Shanghai to improve social security. Better social security system can also help Shanghai to attract excellent workers. At the same time, Shanghai's strong economic power makes it possible for Shanghai to Improve its Social Security system. Shanghai's insurance system is supported by its high financial revenue and expenditure. From the perspective of the proportion of social security expenditure, there's little difference between Shanghai and the national level, at around 11%. But due to the high level of Shanghai's income and expenditure, the total amount of social security expenditure is larger. Shanghai's expenditure on social security was 44.3 billion in 2012 (10.6% of total), or 3,104.6 RMB per capita – while the national average was 1,199.99 billion (11% of total), or 886.2 RMB per capita.

Minimum living standards increased to 570 RMB/month in 2012, 12.9% more than 2011; the minimum wage in Shanghai was 1,450 RMB/month, increased by 13.3% year on year. While Beijing's minimum living standard was 580RMB/month, minimum wage was 1,400 RMB/month, almost the same as Shanghai. Shanghai's government improved minimum living standards and minimum wage to secure low-income people's life. Shanghai has basically established a pension system at the end of 2012. Shanghai had 632 pension institutions in total, with 105,215 beds. The figure 2-9 shows the number of people who have participated in security system. The figure 2-10 shows the increase of minimum living standards and minimum wage.

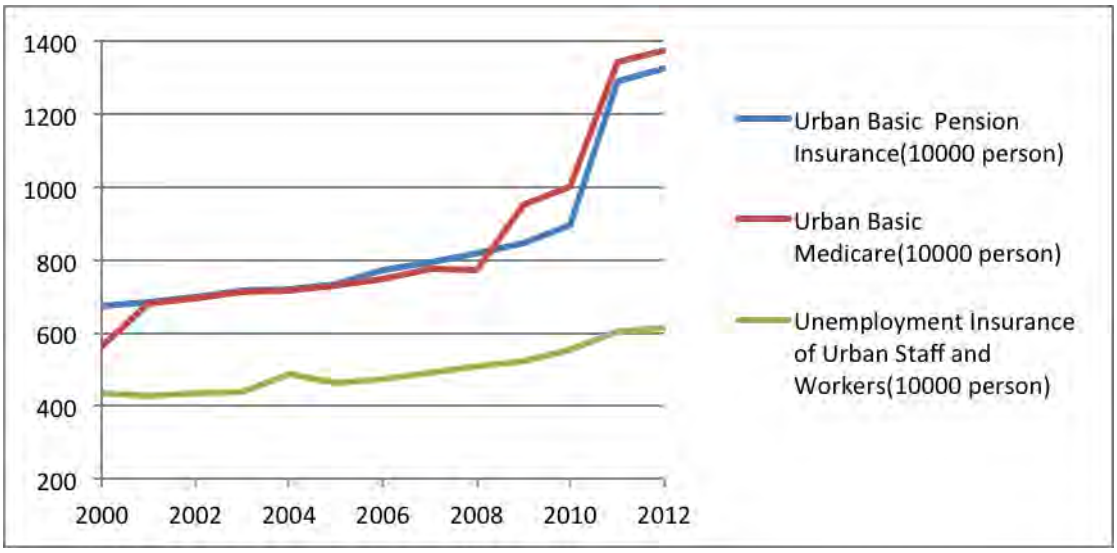


Fig. 2-9 People participating in the security system

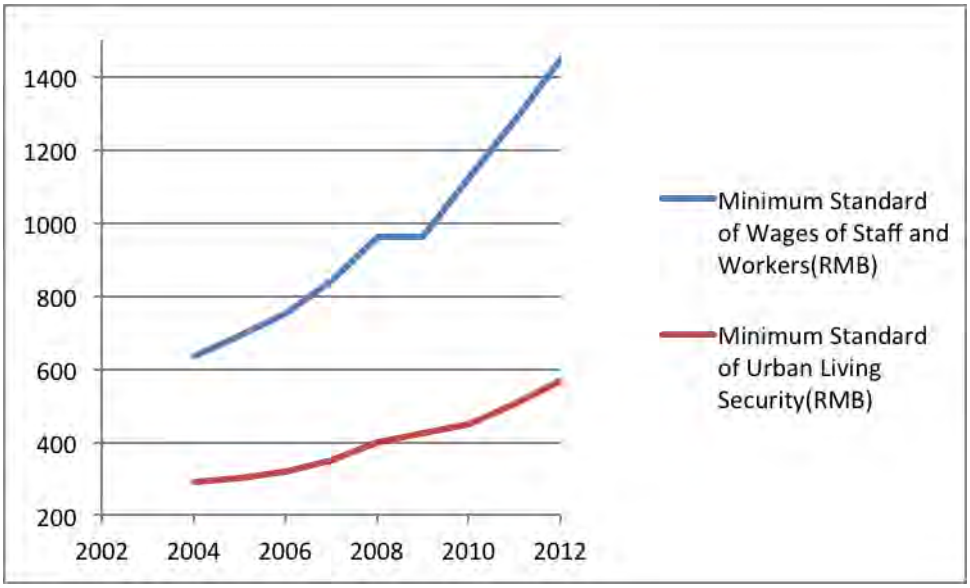


Fig. 2-10 minimum living standards and wage

b. Economy

i. Industrial structure

Shanghai's GDP in 2012 was 2,018.17 billion RMB, increased by 5.14% year on year, GDP Per capita reached 152,703.25 RMB, greater than 2011 values by 8,063.73 RMB. Of 2012's 2,018.17 billion RMB GDP, primary industry contributed 12.78 billion RMB, with an increase of 2.29% from 2011; the secondary industry generated 785.48 billion RMB, a decrease of 0.92%; and the tertiary industry rose to 1,219.92 billion RMB, an increase of 9.48%, accounting for 60.4% of Shanghai's economy. The proportion of tertiary industry increased to more than 60%, which means Shanghai's economy is now based on the service industry, but in most international metropolis, the total production of the services sector basically accounts for 70% or above, so Shanghai still needs to develop the service industry. The figure 2-11 shows Shanghai' GDP and the figure 2-12 below shows industrial structure.

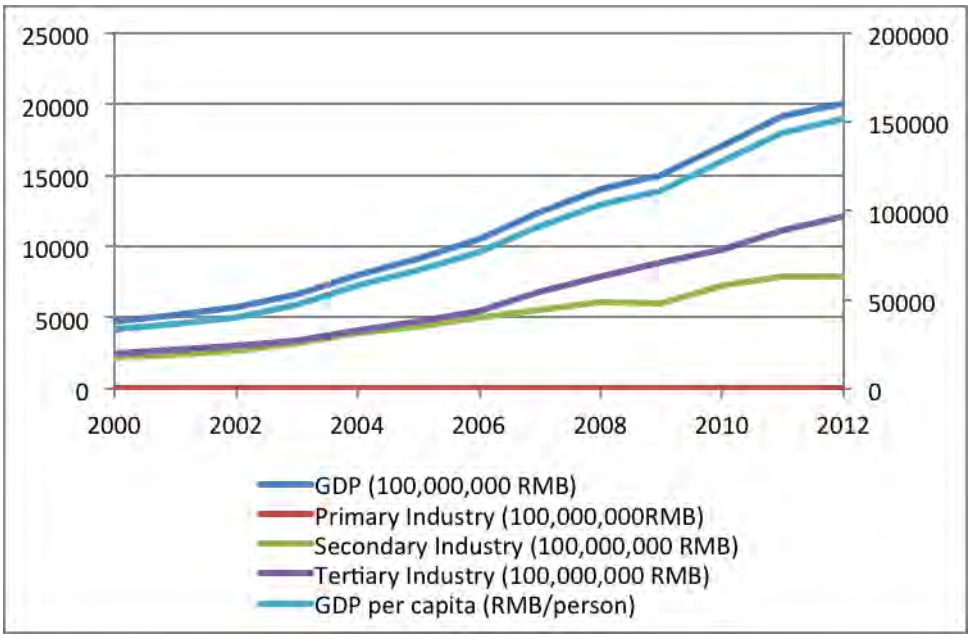


Fig. 2-11 Shanghai' GDP structure

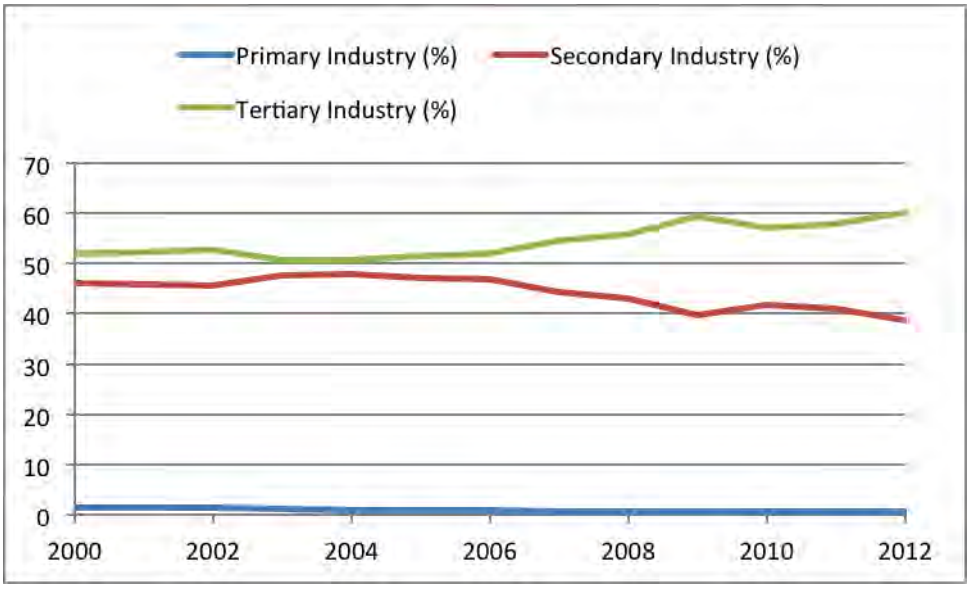


Fig. 2-12 Shanghai's industry structure

ii. Government revenues and expenses

From 2000 to 2012, fiscal revenue and expenditure both showed trends of rapid growth. In 2012, Shanghai district's year-end fiscal revenue was 374.37 billion RMB, a 9.2% increase from the year before, of which tax revenue was 342.68 billion RMB, an 8% increase. Fiscal expenditure was 418.4 billion RMB, a 6.9% increase from the year before; of which, science and technology expenses grew 18.1%, health costs grew 3.8%, and social security grew 7.3%. Figure 2-13 shows the changes of fiscal revenue and expenses over the years.

As the data shows, Shanghai government has been running a fiscal deficit in recent years, which is actually a ubiquitous phenomenon in China. In fact, the deficit level of Shanghai is not as high as that of Chongqing. There was no specific policy on this issue in place until 2011. Since 2011, however, the central government proposed the issue of local government bonds to ameliorate such a situation. Due to the economic strength of Shanghai, it became the first issuer of local government bonds, which have enjoyed great popularity. Currently, Shanghai's government mainly raises funds by loaning and issuing local government bonds.

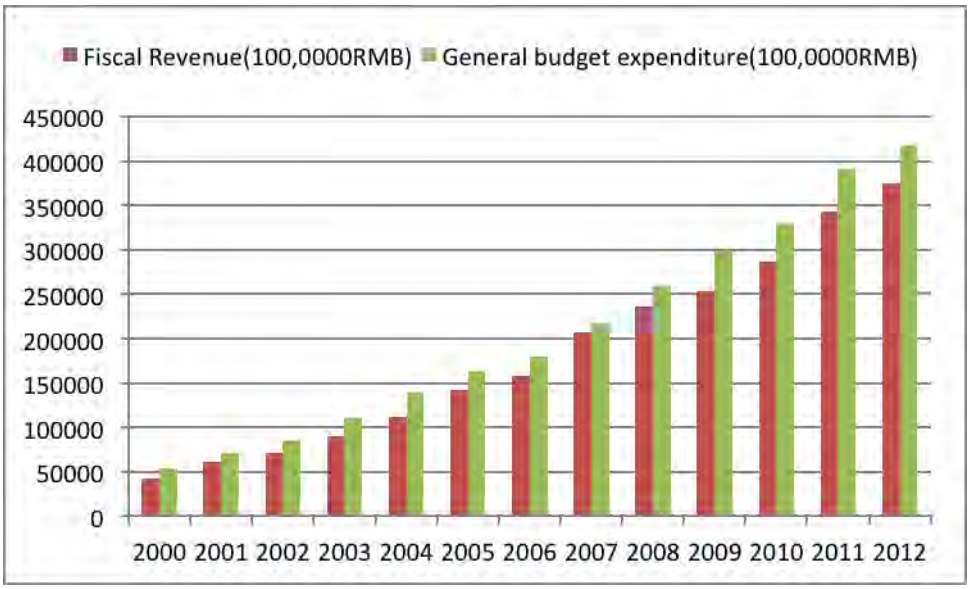


Fig. 2-13 A Record of Changes in Fiscal Revenue and Expenses over the years

iii. Labor and employment

In 2012, the entire district had 11.16 million industrial employees, 111.7 thousand people more than the year before. Of these, primary industry had 457 thousand people, 84.2 thousand more; secondary industry had 4.40 million people, 51.2 thousand fewer; and tertiary industry had 6.30 million people, 78.7 thousand more. That means the total employment was increasing, and many workers transferred from the second industry to the tertiary industry, promoting the development of tertiary industry. From 2000 to 2012, primary industries saw an overall decreasing trend in their employment numbers, whereas tertiary employment numbers keeps rising, at a value larger than the other two industries. Secondary industries saw a clear increase in 2008, and remained stable from at other time (see figure 2-14). At the end of the year, there were 9.44 million staff and workers, an increase of 0.76 million people, with the average salary at 56,300 RMB, 8.3% greater than the previous year. The year-end unemployment number was at 270.5 thousand people, creating an unemployment rate of 4.2%.

The salaries in Shanghai were 56,648 RMB in 2012, higher than the national average 46,769 RMB. But the living cost in Shanghai makes it very difficult to live in Shanghai, the average living cost in Shanghai was 44,023 RMB in 2012, while the national average cost was 22,341 RMB.

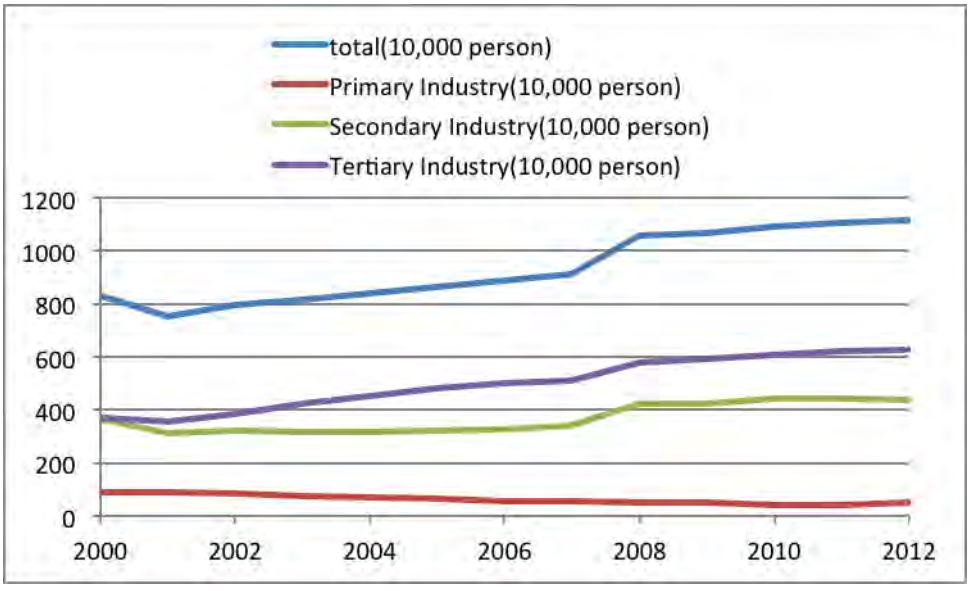


Fig. 2-14 The Changing Trends of the Three Industries' Employment

c. Ecological environment

i. Natural resource endowments

Shanghai lacks both water and land.

Shanghai's water mainly comes from the Huangpu River, with a total of 2.07 billion m3 in 2011, 43.7% fewer than 2010. Water resource per capita in 2012 was 89.12 m3, much lower than the average level in the world, which was...?. Water resource decreased rapidly from 2008 (see the figure 2-15), including groundwater, which reduced to 743.4 million m3 in 2012.

As for the land, according to the 2011 survey data of Land Use Change in Shanghai District, the total land area is 8,239 km2, rural land is 3,674 km2, 44.6% of the total land; land used for construction is 2,535 km2, 30.8% of the total land; and "other land areas" are 2,029 km2, 24.6% of the total land.

Shanghai's high life quality and good job opportunities attracted a large influx of foreign workers, especially for Pudong, which increases the burden on land and water.

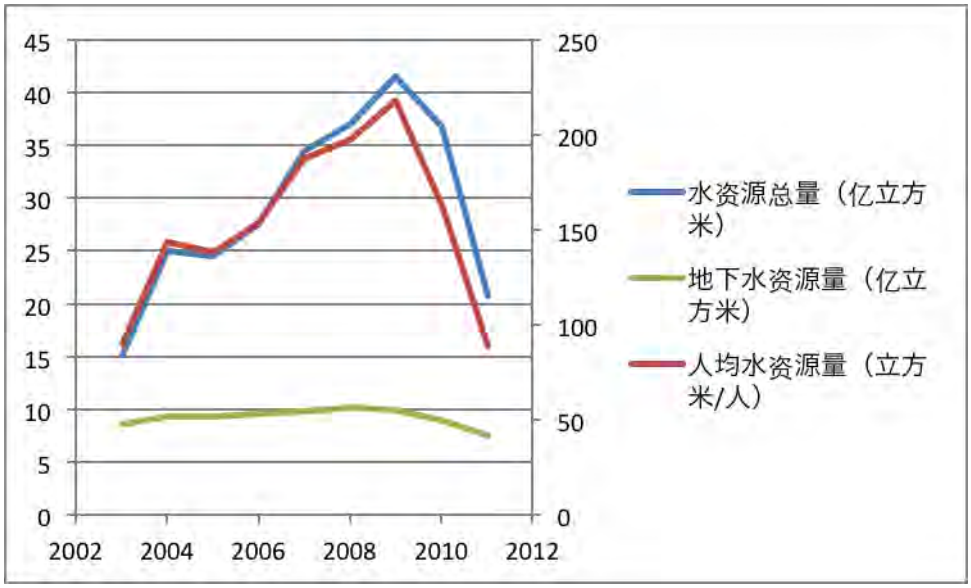


Fig. 2-15 Water resource in Shanghai

ii. Air quality and pollution emissions

In 2011, Shanghai's urban air had averaged yearly sulfur dioxide emissions at 0.029 mg/m3; yearly nitrogen dioxide average at 0.051 mg/m3; and the yearly average of PM10 was 0.080 mg/m3. The urban sulfur dioxide, nitrogen dioxide and PM10's yearly average concentration, according to Environmental Air Quality Standards (GB3095-1996 and amendments), were not within the Grade B standard concentration limits. Sulfur dioxide's average concentrations reached Environmental Air Quality Standards (GB3095-1996 and amendments) Grade B standard concentration limits. The number of days with good air quality (Reach Grade B Air Quality Standard) gradually increased over the year (see figure 2-16).

Figure 2-17 shows the condition of industrial emissions, from which we can see the decrease of SO2 emissions, and an increase of waste gas emission. The reduction of SO_2 emission is due to the concentration on such issue of the central government. In 2009, Shanghai closed numerous small factories, especially small power plants according to the newly-made policies of the central government. Those small factories were heavy polluters and hard to control. After their shut down, the emission of SO_2 was efficiently reduced. The acid rain issue is quite serious in Shanghai, where the frequency can reach 80%. Since SO_2 is one of the main causes for acid rain, the decreasing of SO_2 emission is very meaningful to the city.

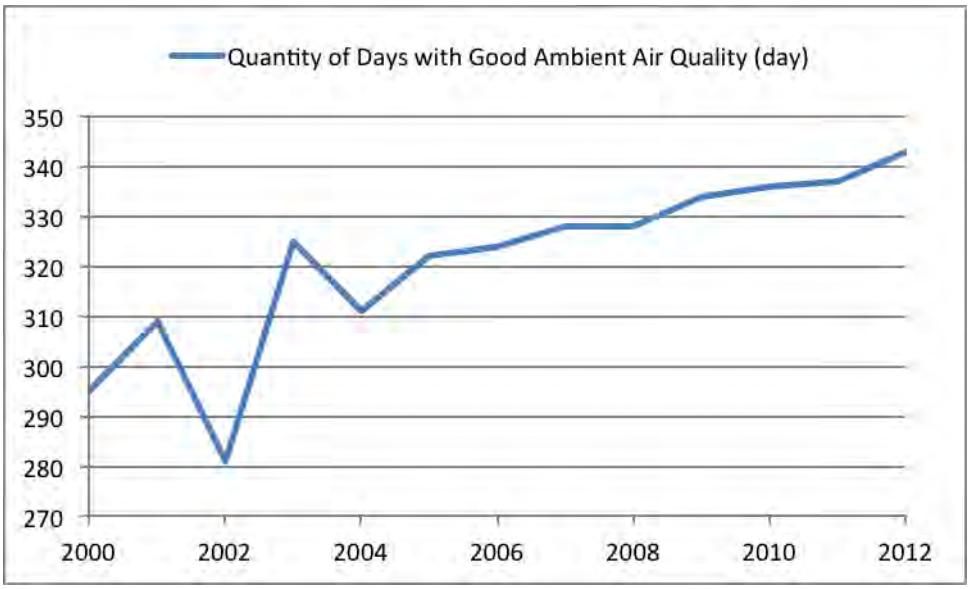


Fig. 2-16 The change of days with good air quality

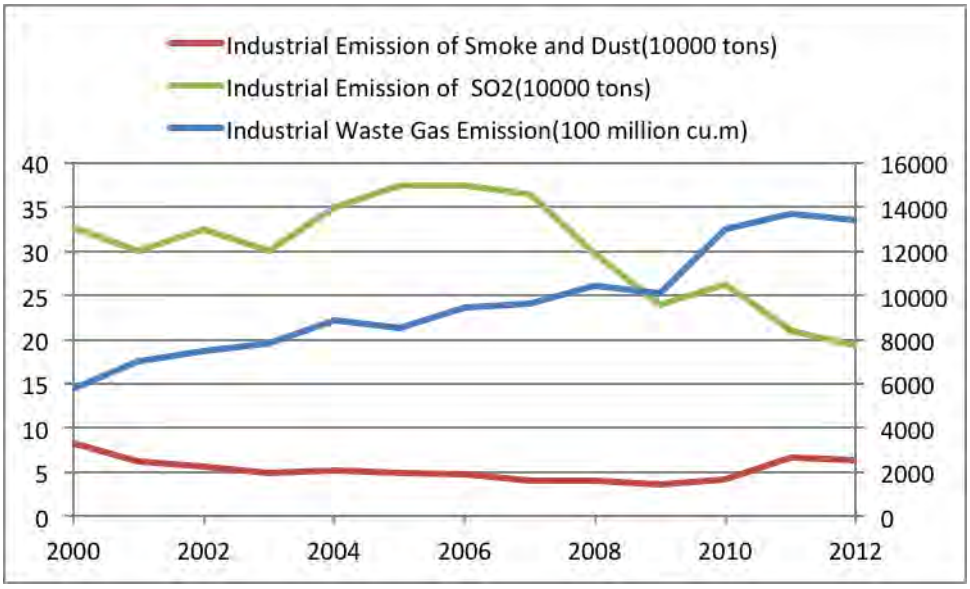


Fig. 2-17 The condition of industrial emission

iii. Water quality and pollution emissions

In 2012, the length of river superior to class III water (containing class III) was 202.5 kilometers, accounting for 28.2% of total river length in evaluation; the length of class IV River was 159.3 kilometers, accounting for 22.1%; V class River was 89.4 km long, accounting for 12.4%; rivel inferior to V class was 268.6 kilometers, accounting for 37.3%.

Figure 2-18 below shows the condition of waste water discharged. Total discharged waste water remained stable between 2000 and 2012, while industrial waste water shows some decrease, together with industrial emission of COD. The improvement of environmental quality was caused by a decrease on the industrial sector proportion of economy, technology improvement of pollution treatment, and increasing investment on the environment.

The environmental investment in Shanghai was 57 billion, accounting for 2.83% of GDP, while the national average environmental investment was 825.4 billion, 1.59% of GDP. Shanghai can invest so much on the environment mainly because construction of infrastructure has been nearly completed for years now.

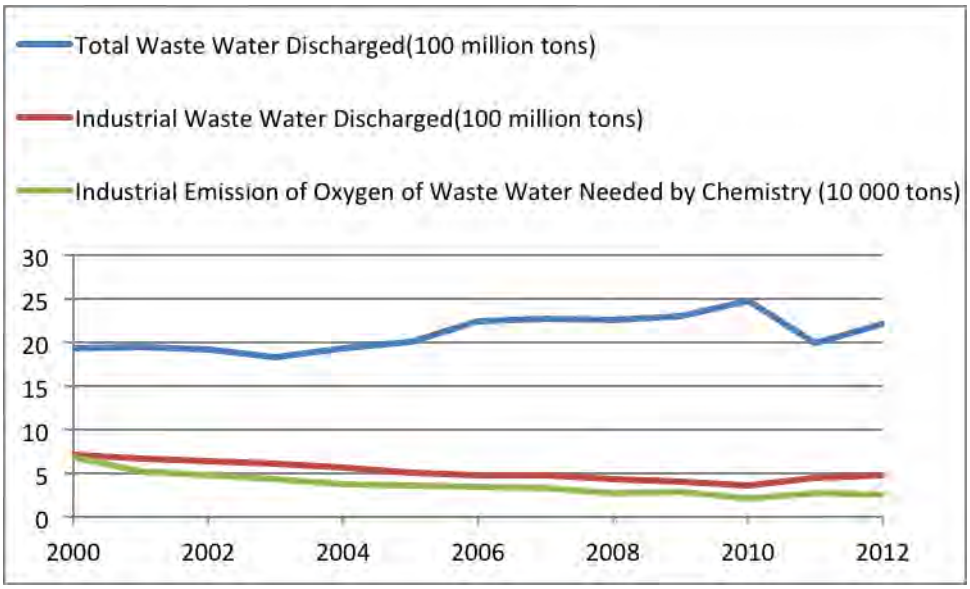


Fig. 2-18 The condition of discharged waste water

iv. Solid waste generation and emissions

The source of solid waste in Shanghai district is primarily from industrial and residential production. Overall, industrial solid waste increased over the years (see figure 2-19), but there has been some fluctuation since 2009. Industrial solid waste in 2012 is 21.99 million tons, 2.43 million tons fewer than 2011. The utilization rate of industrial waste reached 97.34% in 2012.

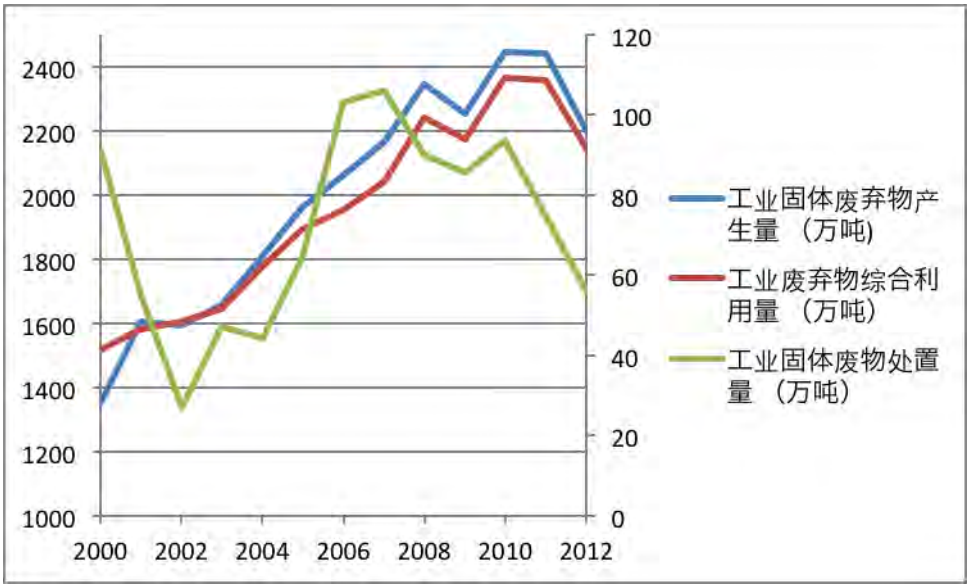
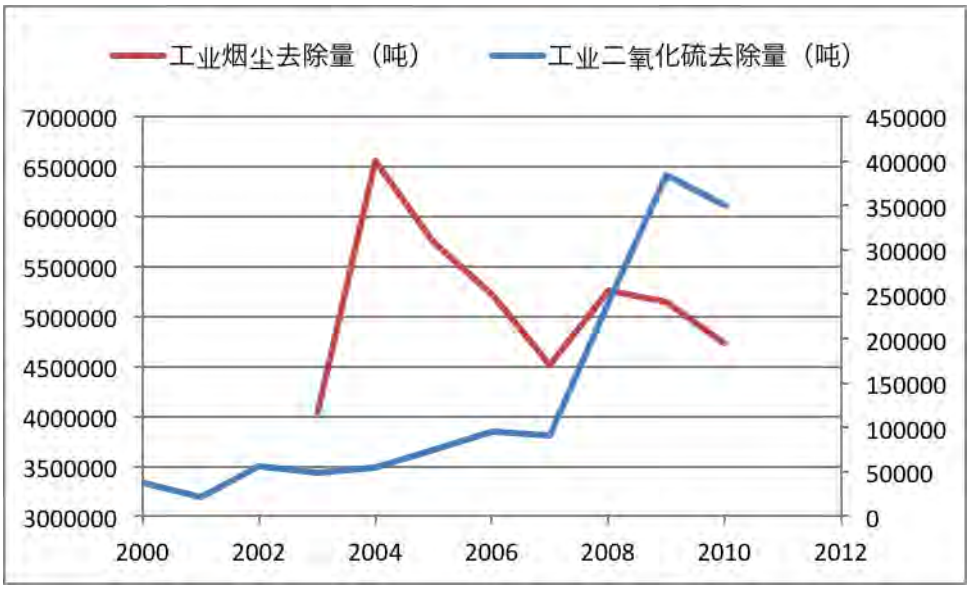


Fig. 2-19 Shanghai's Industrial Solid Waste Emissions legend in English is needed

v. Environmental pollution control facilities

Regarding Shanghai's treatment of industrial atmospheric waste pollutants in recent years, the overall situation is fairly good, especially for SO2. From 2007 to 2009, the treatment of SO2 increased rapidly from 90.277 tons to 384.624 tons.

Industrial dust removal peaked in 2004, after which it was kept at a low level, because Shanghai's government has concentrated efforts on reducing industrial dust since 2004. After the improvement of technology, the amount of dust produced declined, so dust removal also declined.



Removal amount of Industrial smoke and dust (tons) / Removal amount of so2 (tons)

Fig. 2-20 Shanghai's Industrial Atmospheric Waste Pollutant Treatment

In recent years, benefiting from the construction of sewage treatment plants and pipelines, Shanghai's industrial wastewater treatment shows an ever-increasing trend of capacity, from 230.28 million tons treated in 2000 to 2,006.85 million tons in 2012. Meanwhile, the wastewater compliance rate increased from 93.2% in 2000 to 98% in 2010.

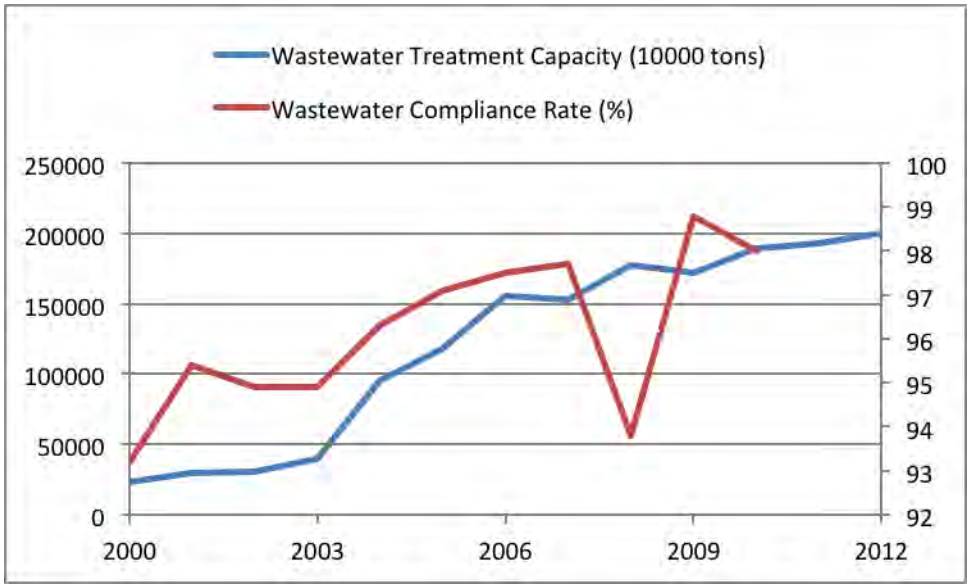


Fig. 2-21 Shanghai's Wastewater Pollutant Treatment

With regard to the past few years' environmental protection expenditure[93], the amount has seen an overall increase (see figure 2-22); the fiscal budget's expenses on environmental remained relatively stable, varying between 2.8% and 3.1%.

[93] Including environmental management expenses, environmental monitoring and monitoring expenses, pollution control expenditures, expenditures for natural ecological protection, natural forest protection project expenditures, forest spending, desert sand control spending, pasture spending, has cultivated grassland pasture, energy conservation, pollution reduction, renewable energy and resource comprehensive utilization expenditures.

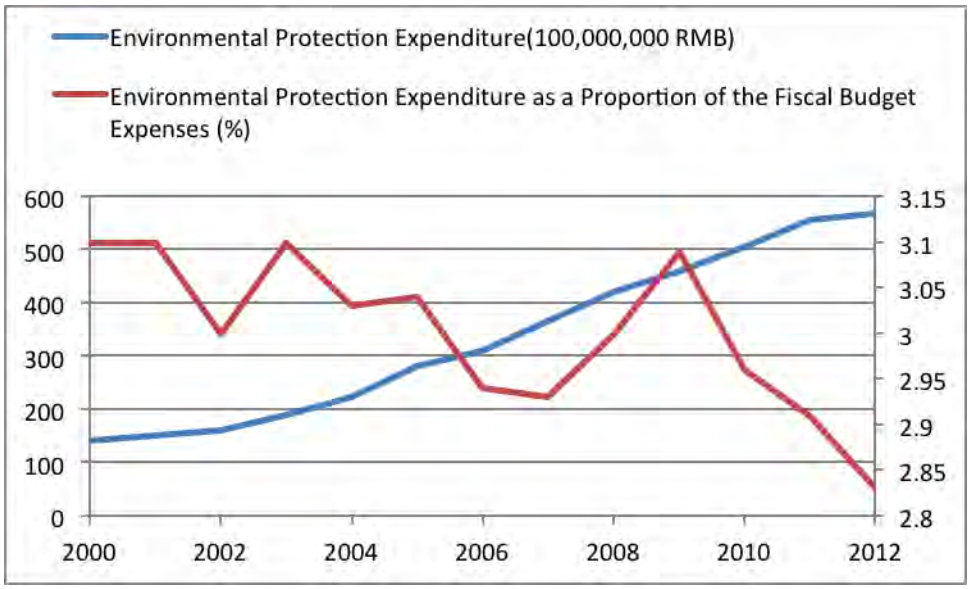


Fig. 2-22 Shanghai's Environmental Protection Expenditure

d. Energy systems

i. Energy classification

Energy resources can be divided into non-renewable or conventional energy and renewable energy resources.

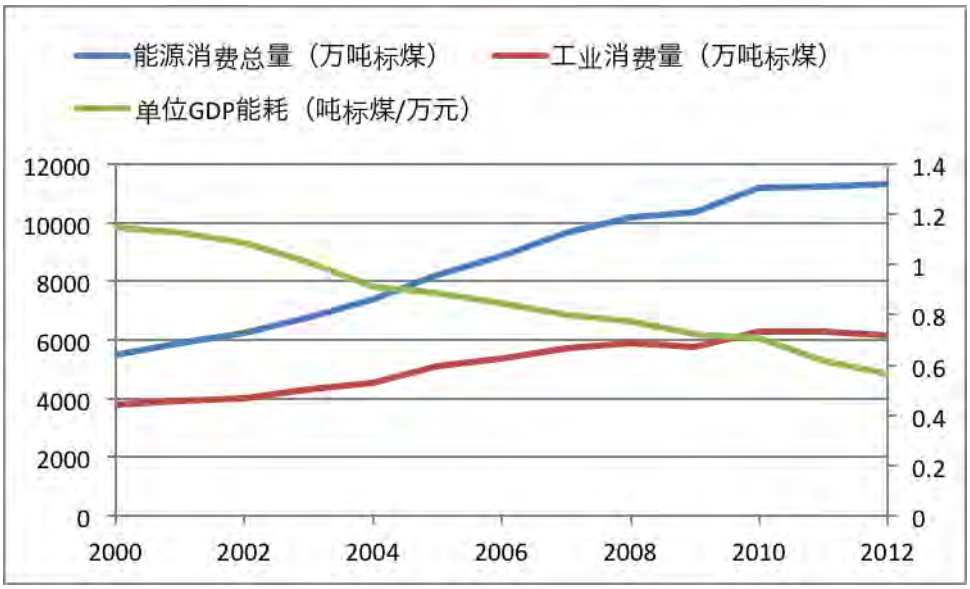
Availability of petroleum is limited. Petroleum products are energy-rich components of carbon which have undergone anaerobic degradation with the help of sun's energy. The problem with fossil fuels or petroleum products is that, they release a lot of pollutants, when used. Shanghai is poor in fossil fuels or other non-renewable resources such as minerals.

As for renewable or non-conventional energy resources, such as solar radiation, wind power, hydropower, biomass and nuclear power, Shanghai is only rich in water resource for it has more than 2000 rivers in the whole district. However, as the pollution gets more and more severe, Shanghai city now suffers an extreme lack of clean water.

ii. Primary energy consumption

Shanghai's energy consumption has grown over the years (see figure 2-23), with 113.62 million tons of coal equivalent consumed in 2012, twice the amount consumed in 2000. The value for 2012 was greater than 2011 by 0.8%.

With economic development, Shanghai's energy demand and consumption increases year after year. However, the energy consumption per unit of GDP has been steadily decreasing, as a result of improvements on energy efficiency and economic restructuring, having declined from 11.5 thousand in 2000 to 5.7 thousand in 2012, a decrease of 50%. Industrial energy consumption grew rapidly before 2007, but due to the economic transformation of Shanghai and the dimishing proportion of industry, the industrial energy consumption remained stable after 2008.



Total energy consumption (10000 tce)

Industrial energy consumption (10000 tce)

Energy consumption per unit of GDP (tce/10000RMB)

Fig. 2-23 Shanghai's Energy Consumption Amount

e. Infrastructure

i. Built-up area status

According to the 2008 Shanghai District land use change data, figure 2-24 below shows how the land is split for natural and industrial purposes. By the end of 2008, the total area of the district was 8,239 km2, which includes 2,525 km2 land for Construction, 11.8% more than 2003.

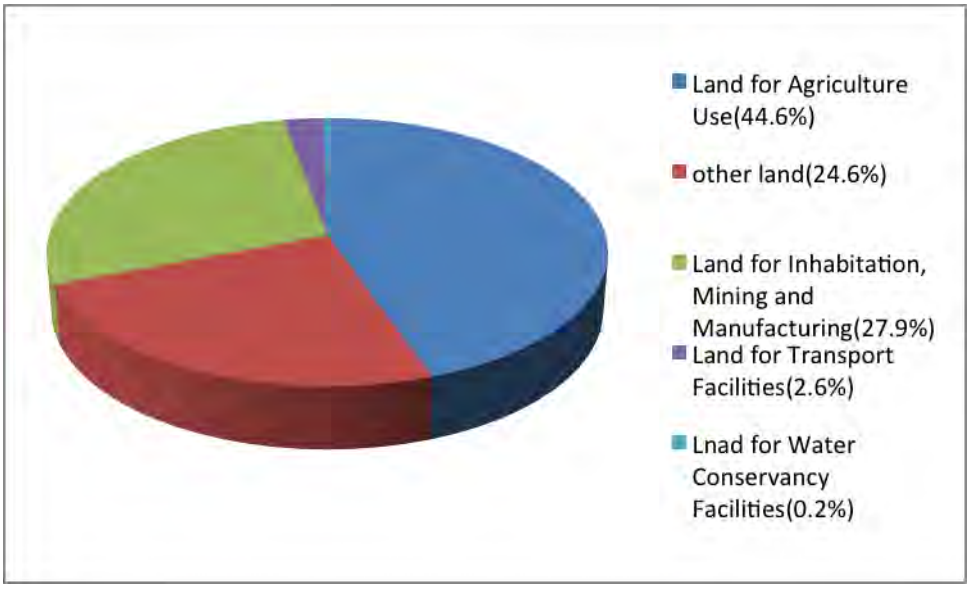


Fig. 2-24 Built-up Land Use of Shanghai

ii. Road conditions

By the end of 2011, Shanghai's area of paved roads reached 94.81 km2, having increased 13.4% from 2008 values; between the years 2000 and 2012, Shanghai's area of paved roads per person increased by 160%, from 7.17 m2 to 18.88 m2. Figure 2-25 below shows the increase of Area of Roads per Capita.

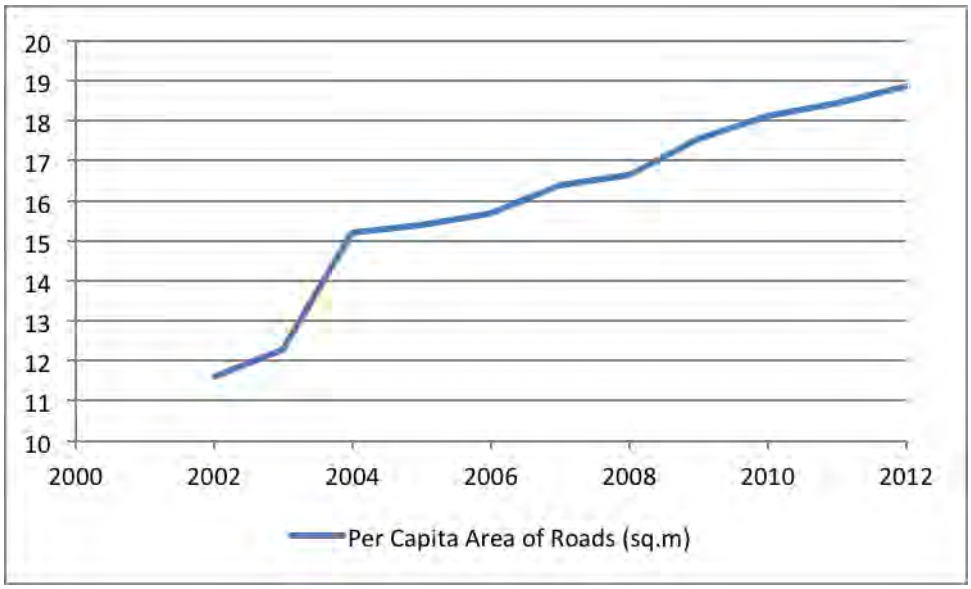


Fig. 2-25 Area of Roads Per Capita in Shanghai

iii. Public transport

In the Shanghai area there are three main forms of public transportation: bus, taxi or Urban Metro (subway). As of 2012, there were 163,336 buses, 49,803 taxis, and 13 lines of metro. The total length of road was 12,541 km, 110% more than in 2000. Passengers.kms was 2.99 thousand, while that value in 2000 was 4.16 thousand. The district database indicates that the number of taxis had increased 18% from 2000 while the number of buses increased from 16,000 to 19,000.

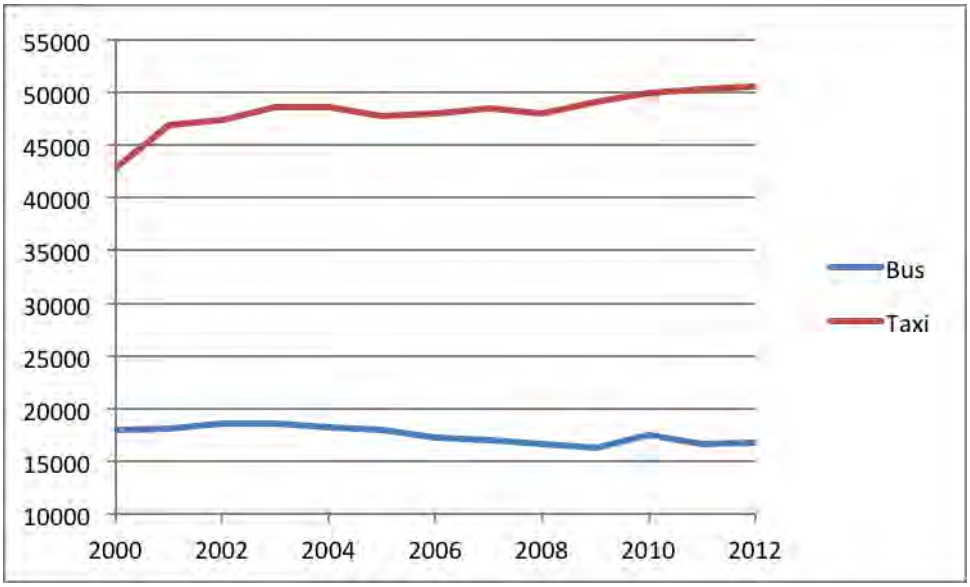


Fig. 2-26 The changes of public transport in Shanghai

iv. Private transport

Residents in Shanghai use private cars, motorcycles, or bicycles as their vehicles. From the data provided by government, in 2012 the number of private cars in Shanghai was 1.4084 million, an increase of over 800% from 2002 figures. At the end of 2012, every 100 families in urban areas had 20 cars on the average. Meanwhile, the number of motorcycles decreased from 1,259.5 thousand in 2010 to 412.3 in 2012.

Increase of private cars in Shanghai leads to traffic jams. Shanghai uses an auction system of license plate number to limit the number of private cars in circulation. This policy allocates private cars to people who really need it, but it also makes it more difficult to lower-income families to own a car.

v. Intercity and international traffic

There are 2 civil airports, 4 railway stations, 41 bus stations and 6 wharfs in Shanghai. For international travel, the common form of transportation is by airplane, PuDong international airport is mainly used for travelling abroad. Shanghai's wharfs play an important role in international trading and shipping, exporting goods to Europe, America, Australia, and other countries in Asian.

vi. Residential

In China, most cities' living space per capital is small and house price is high, especially for big cities like Beijing/Shanghai.

At the end of 2012, urban residents' per capita living space was 17.3 m2, or 5.5 m2 more than in 2000; while rural residents' per capita living space was 60.42 m2, or 6.84 m2 more than in 2000. In Beijing, urban residents' living space per capital was 29.26 m2, or 11.96 m2 more than Shanghai. Chinese urban residents' living space per capital on average was 32.7 in 2011 (no statistic for 2012).

Over these years, the housing price of Shanghai kept rising, and average price in 2012 was 23,113 RMB/ m2 (Beijing was 22,161 RMB/ m2, Shenzhen was 24,550 RMB/m2), while the average wage of Shanghai residents in 2012 is 56,648 RMB. Therefore, many people in Shanghai can't afford a house.

2.3 Analysis and Conclusion

a. Shanghai: Development potential and dilemmas

i. Shanghai's development potential

As the biggest city of China, Shanghai' has good development potential, which could be synthesized in the following aspects:

First, Shanghai's advantageous location provides an excellent opportunity for Shanghai's trading economic. Sitting at the mouth of the Yangtze River, Shanghai has the biggest foreign trade port and the biggest industrial base of China, which enhance the external trade of Shanghai.

Second, Shanghai's opening-up policy makes it attractive to foreign investment. After more than 30 years' opening up, Shanghai has become one of the largest city which has the largest scale of foreign capital, the widest area of investment, and the best foreign investment efficiency in China.

Third, Shanghai's tertiary industry is well developed. With the establishment of China (Shanghai) Pilot Free Trade Zone, Shanghai's financial industry is expected to boom.

In addition, Shanghai's tourism resource is also plentiful, which contributes to the economy development.

ii. Shanghai's development dilemmas

High speed economic growth rate as we can see, there are, however, some problems hidden behind the city. Shanghai's development dilemmas can be divided into the following parts:

From the economic aspect, most of Shanghai's emerging industries like new energy vehicles, marine engineering was composited by SOEs, which need more momentum and innovation to develop.

For ecological and environmental protection, Shanghai is lack of natural resource, such as clean water and land, which set another restriction to the development. And Shanghai has some environmental problems such as acid rain, polluted air, polluted water, etc.

As for dilemmas in social development, Shanghai is facing the challenge of aging and population decline. And Shanghai's high house pricing and living cost make it hard for young people to live a life, especially for workers from other province.

b. Shanghai development model and trends of sustainable urbanization

Shanghai's development is benefiting from the opening-up policy and tourism resource. By attracting foreign capital, developing the producing industry, and foreign trading, Shanghai established the fundamental basis of economy. And after that, Shanghai adjusted industry instruction to develop the service economy and aimed at establishing the financial central of Asian.

Shanghai's further development is relayed developing sustainable industries, improving the quality of industries, and forming a innovation-driven economy.

3 Chongqing

3.1 Introduction

b. Overview

Chongqing is situated in the southwestern part of China, at the transitional area between the Qinghai-Tibet Plateau and the plain on the middle and lower reaches of the Yangtze River in the sub-tropical climate zone swept by the moist monsoon. The land under Chongqing's jurisdiction is 470 kilometers from east to west, and 450 kilometers from north to south. It borders on Hubei and Hunan provinces in the east, Guizhou in the south, Sichuan in the west and north and Shaanxi Province at its northeast corner.

c. purpose/scope/methods

The purpose of this report is to propose development models and trends of sustainable urbanization for Chongqing by analyzing the current situation and seeking feasible solutions to the present obstacles of the district's further urban development.

In this analysis, the possible path of urbanization in Chongqing is evaluated from various perspectives relevant to WP4 themes, specifically economic, environmental and social factors.

3.2 Chongqing Urbanization Current Situation

a. Society

i. Population

By the end of 2011, total resident population of Chongqing was 29,190,000. In 2011, birth rate reduced to 9.88‰ compared to a figure of 11.43‰ in the year 2010; and the rate of population natural growth reduced to 3.17‰ from 6.24‰. Total birth rate of women of childbearing age was maintained at 1.5, lower than the replacement level, making a historical change of type of population reproduction from the stage of stabilizing low birth rate into the stage featured with low birth rate of solving population problems from an integrated view.

Although the reduction in population may be attributed to the widely adopted one-child policy in China since the 1980s, other reasons cannot be ignored as drivers of demographic changes. Firstly, there is increasing evidence that inflation in urban areas is persuading couples to voluntarily reduce the number of children they have. Besides, essential factors such as the cost of living also plays an important role in young couples' decision whether and when to have their babies. For whatever reasons, accompanied with the rapid growth of urbanization, lifestyles chosen by nowadays married young couples have changed greatly in contrast with the traditional ways of living. They do not have a baby as soon as they have married but tend to struggle themselves concerning prior issues such as earning a house of their own. Fierce competition in the society makes them less motivated in having a baby for a new member in the family may mean a heavier burden for the life. Apart from uniform policy, important issues rooted deeply in the life pattern of modern urban residents may significantly determine their discretionary choices under realistic issues; the growth in population of Chongqing has slowed its pace. Though not as extreme as the circumstance in Shanghai whose birth rate has already been negative, the case of Chongqing can still predict the future reduction in birth rate.

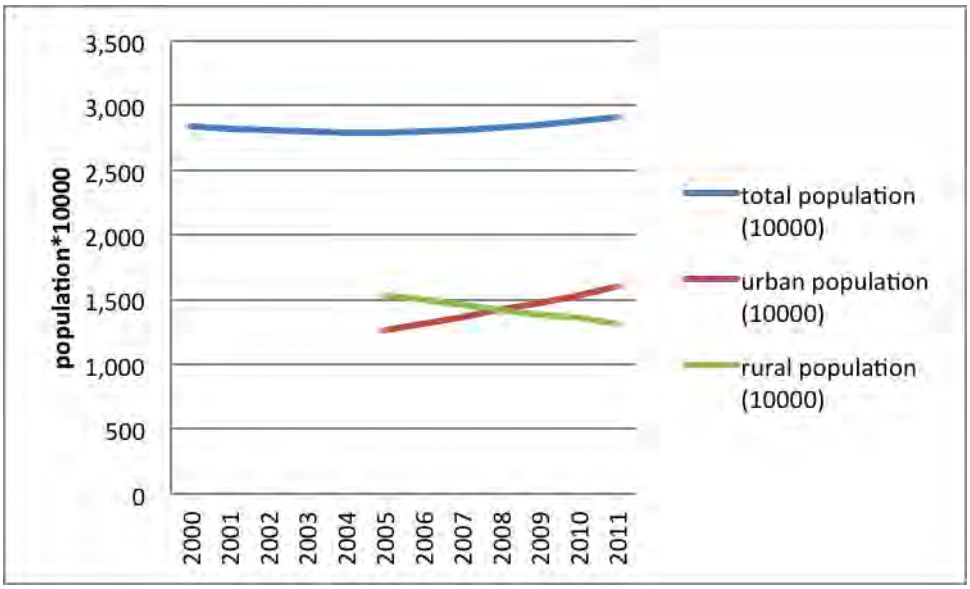


Fig. 3-1 Chongqing 2000-2011 Population Structure

Figure 3-1 indicates a significant rise in urban population between 2005 and 2011, while the total population remains steady through these years. This trend of increasing urban population can be also seen on figure 3-2. By 2011, the urban population proportion was 55.02% and it is very likely that urban population growth will continue in the foreseeable future. In 2012, urban population accounted for 57% of the total population and the total people living in the urban area was 16.8 million. Workforce from the southwestern part of China flows into the city of Chongqing in order to meet demand for human resources. Comparing Chongqing's average per capita income to that of Chengdu (the nearest largest city, 300 kilometers from Chongqing, with approximately 14 million people), income level in Chongqing is twice as high as in Chengdu. Therefore, the large rural population that keeps migrating into large cities in search of economic opportunities is likely to choose Chongqing as their first destination in the region. On the other hand, both Shenzhen and Shanghai are approximately 2,000 kilometers distant from Chongqing, which makes the city the main regional economic center, on which rural residents are more likely to have personal connections.

In the next ten to twenty years, there appear to be few geographical (physical?) limits to Chongqing's potential growth. Chongqing is the largest municipality in area compared with the other three direct-controlled municipalities of China. In fact its area is 2.4 times the sum of the other three municipalities, with 82.4 thousand Km2. Thus, the potential land available for further expansion of the city is promising and Chongqing is currently not yet fully utilizes its land in whole administrative region. Most of the area is interspersed with counties, surrounding the urban area, which have been in underdeveloped status. Apart from the downtown area of the city, there still exists large proportion of the total land in the realm establishing basis for the consecutive spreading.

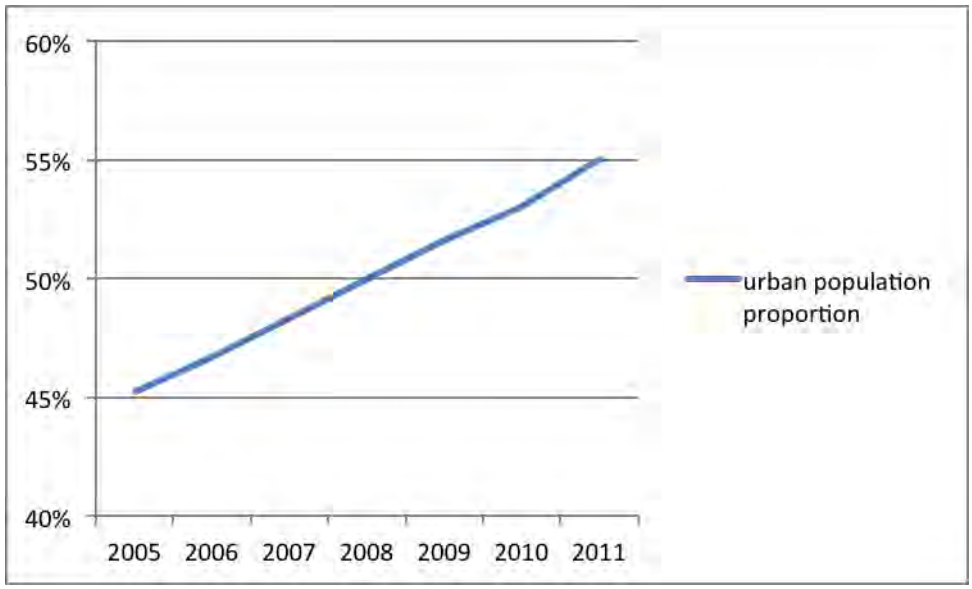


Fig. 3-2 Urban Population Proportion (2005-2011)

ii. Education

By the year 2012, there were 11,200 schools in the city with 6.1 million enrolled students. There were 67 universities or colleges with 0.89 million students, 262 high schools with 0.66 million students, 969 junior schools with 1.08 million students, 4,810 primary schools with 1.94 million students and 4,401 kindergartens with 0.89 million children. The number of students per primary school is 372.4, below the national average of 411, while the number of teachers per primary school is 22.2, slightly lower than the national mean of 23.1. Such two figures for junior high schools are respectively 1194, more than the national average of 936, and 77, more than the average of 65.1. As well, such two figures in high schools are higher than the national average. Teachers in universities and colleges of Chongqing are 551.8 per institute, slightly lower than the national average of 560.8. The student-teacher ratio of Chongqing in higher education institutes is 17.43, slightly lower than that of Beijing, Tianjin and Shanghai whose ratio are respectively 16.18, 17.03 and 16.92. However, an apparent discrepancy in such ratio exists with regard to regular high schools. Compared with the ratios of 9.6, 12.23 and 9.7 in Beijing, Tianjin and Shanghai, Chongqing's student-teacher ratio in high schools is 18.95, almost twice the amount of Beijing or Shanghai. This figure could strongly indicate a fundamental fault in Chongqing's education. The enrollment rate for compulsory education was 99.8 % and the rate of standardization of primary and junior schools was 75%. The enrollment rate for universities and colleges was 34%. The total expense on education was 65.5 billion RMB, up 30% over the previous year.

Chongqing and Shanghai have similar numbers of universities, colleges and senior high schools; and the number of junior high schools is even greater than Beijing and Shanghai. However, there are significant differences in quality. In general, Chinese education largely depends on the funds of both local and central government, for private educational institutes are rare in mainland China. Such government funds in Beijing and Shanghai were respectively 51.3 billion RMB and 44.1 billion RMB in 2011. In contrast, over the same period Chongqing received only 28.9 billion RMB. The financial support in education could not be seem as sufficient, when compared with its peer cities. Thus, given the lack of adequate public financial support to education, it is not hard to explain the disparity between employed teachers in Shanghai and those in Chongqing. In addition, the average salary for hired people in education is 24,000 RMB per year. However, teachers and other relevant job-takers in Beijing, Shanghai and Tianjin could earn 38,035, 31,802 and 33,398 RMB a year, respectively. Insufficient wages for teachers may also be seem as an obstacle for the development of Chongqing's educational field. Therefore, according to the number of students per school, student-teacher ratio, governmental support for education and wage level of the educational enterprises, Chongqing offers

average level of education in primary education. But the faculty is not sufficient enough for both primary and higher education. Chongqing's status of education can be regarded average when judged by national criteria but quite deficient when compared with its peer municipalities like Beijing and Shanghai.

iii. Culture

Chongqing is a famous historic city in China and the cradle of Ba Ethnic culture, enjoying a great cultural heritage. It is a component of the Chinese culture that maintains unique regional features and cultural patterns. Chongqing is particularly rich in human landscape as well as in cultural relics and historic sites. There are now 49 national, provincial and municipal preservation places of treasured historical relics. In 1999, the UNESCO listed The Dazu Stone Sculptures on the World Register of Cultural Heritage. In its 12 museums and memorial halls, displays and exhibitions are held all year round.

Specifically, people in Chongqing lead a relaxed pace of life. Significantly influenced by the people in Sichuan province, which is coterminous (?? please review this word) to the city, residents in Chongqing enjoy the relatively slow pace of life. Food in the area is particular famous for the Chuan cuisine, featuring hot food stuffs and hotpots. In fact, Sichuan cuisine has spread all over China as one of the dominant branches of food in China. In addition, people in Chongqing are also famous for their preference in leisure time entertainment activities such as playing Majiang with family members and neighbors.

The pace of life and competition in Chongqing is not as fierce as in Beijing and Shanghai, for locals have been long enjoying their traditional ways of living. Also, both the economic standards and the inland location in the western part of China determine that life is not as expensive in Chongqing. Per capita annual cash consumption expenditure of urban households in Chongqing is just 14,974 RMB, with such figure in Beijing and Shanghai being 21,984 and 25,102, respectively. Chongqing figures only have an equivalent in Shandong or Liaoning provinces, lagging far behind provinces such as Zhejiang, Guangdong and Jiangsu. Chongqing can still be called a city affordable to live in, contrasting with other metropolis like Shanghai.

, Funding for basic cultural life in Chongqing, however, cannot be regarded as adequate when compared with that of other metropolitan areas in China. For instance, data from public libraries in Chongqing is quite different from that in Beijing and Shanghai. The number of libraries in Chongqing is about twice that of Beijing or Shanghai; however the number of books per person in Beijing, Shanghai and Chongqing are respectively 1.01, 3.03 and 0.52 copies in 2012. According to other important figures such as the total number of circulation, or the number of lectures held in public libraries, Chongqing was still at about half of the level of Beijing or Shanghai. Great discrepancy is shown from the figures and the basic cultural facilities in Chongqing still require further development to meet the demand for becoming a mature big city in western China.

iv. Social insurance and social assistance

By the end of 2006, about 3.17 million people in Chongqing were covered by the basic pension insurance; 2.55 million covered by the basic medical insurance; and 1.93 million covered by the unemployment insurance. About 349,900 were covered by rural social pension insurance. About 812,800 people were covered by the minimum income security for urban residents, which increased by 55,400, up 7.3%; and 42,900 were covered by the minimum income security for rural residents, which increased by 30,000. In 2011, 13.24 million people had been covered by basic medical insurance in Chongqing. The percentage of coverage was 45.3%, which is higher than the national standard of 35.1%. However, those numbers indicate 66.75%, 71.79% and 67.82% in Beijing, Tianjin and Shanghai respectively. The proportion of government expenditure on social security and employment in Chongqing was, however, actually higher in the year of 2012 than on its peer cities. The percentage of total expenditure in such category was 13% while those of Beijing and Shanghai

were 8.8% and 10.6% in 2012. Furthermore, expenses for social security and employment in Chongqing ranked the second out of all kinds of expenditure in 2012, only behind that for urban and rural community affairs. In contrast, it ranked third in Beijing and Shanghai. Though Chongqing doesn't show better results compared with Beijing and Shanghai in terms of social insurance, particularly in medical care, the governments' efforts in raising the level of social security are reflected on the distribution of public expenditure. With regard to the rapid urbanization, government of Chongqing may precede urban construction affairs but the funding for social insurance and assistance is not lagging behind. Overall, Chongqing's social insurance and assistance is doing well according to the national standard. And Chongqing is speeding up its pace in social security to catch up its equals like Beijing and Shanghai.

The scale of Chongqing's social insurance, including major aspects such as basic pension insurance, unemployment insurance and basic medical care insurance, is growing steadily with the promotion of these basic kinds of insurance by the central government. Social insurance and social assistance are covering more people through a stable process.

b. Economy

v. Industrial structure

In the year of 2012, the gross domestic production was 1,145 billion RMB, increasing 13.6% by the year of 2011. The GDP in the primary industry was 94 billion, up 5.3% over the previous year, while the GDP in the secondary and the tertiary industry were respectively 617.2 billion and 434.7 billion, up 15.6% and 12% over the previous year. The structure proportion of these three industries is 8.2, 53.9 and 37.9. Compared with the same three percentages in Beijing with 0.8, 23.1 and 76.1 respectively in the primary, secondary and tertiary industry and counterparts in Shanghai of 0.7, 41.3 and 58 respectively, Chongqing could be considered as a municipality still with great potential for altering its industrial structure. The structure is not yet mature enough to define the city, as highly developed as metropolis like Beijing and Shanghai are. Chongqing was the last direct-controlled municipality established in China and the only one founded after policies of reform and opening up was launched in 1978. The city does either not like Beijing as the political center of China having priority in gaining public funds, or like Shanghai as the economic center consummate at attracting large amount of foreign investment. Secondly, the location of Chongqing is the indigenous factor influencing the overall developing level of the whole city. Chongqing is not like Shanghai which is located at the coast line and expeditious at engrossing imported resources. The discrepancy between underdeveloped western districts of China and areas near the coast will be hardly eliminated in the foreseeable future and thus the shortage in resources, workforce and transportation may continue to hamper the change in industrial structure of Chongqing. Eventually, Chongqing's pace in altering its industrial structure could be shown by its increasing investment in fixed assets within the tertiary industry. The growth rate was 9% in the year 2011 but in 2012 this figure was 22%. The figure of Shanghai of these two years was -2.8% and 5% and the national growth rate was 22% in 2011. Regarding investment in tertiary industry, sectors such as transportation, services to households and culture and entertainment facilities, Chongqing enjoyed the highest speed in growth. The Chongqing government tries to raise the standard of living for the local citizens, as well as increasingly change the structure of three industries. There is still a lot to do for the government to form a mature distribution of the three industries.

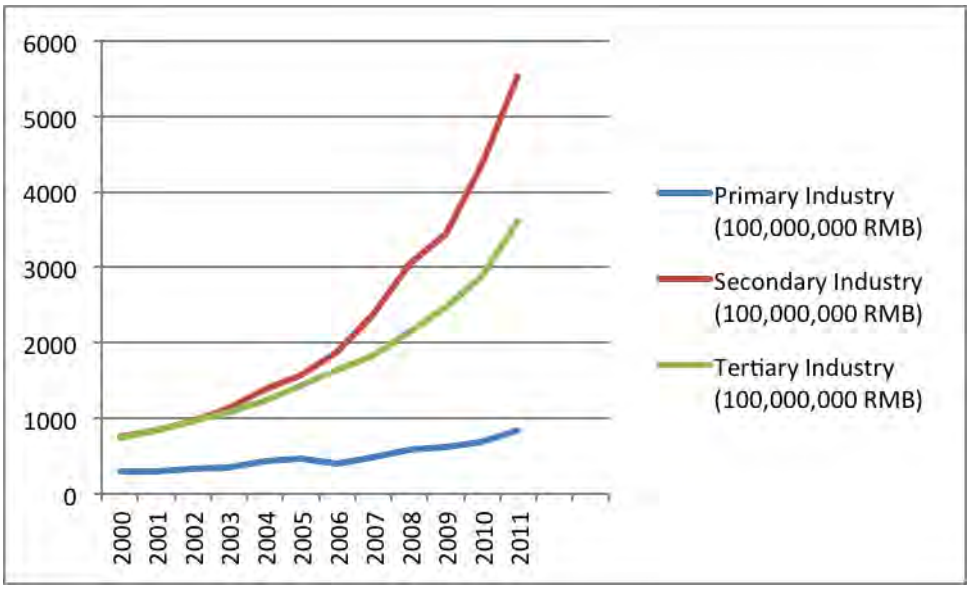


Fig. 3-3 The Economic Development Data of Chongqing (2000-2011)

vi. Government revenues and expenditures, GDP per capita data

In 2012, the GDP per capita was 39,083 RMB, up 12.4% over the previous year. Also, such number is higher than the national average of 35,181 RMB. The government revenue was 170.349 billion RMB, increasing by 14.5%, with tax revenue accounting for 97.017 billion RMB. Government Revenue of Chongqing is about half the amount of Beijing or Shanghai. Government's expenditure was 305.517 billion RMB, increasing by 19.9 %. Such number is lower than that of Beijing or Shanghai whose expenditures were 324.5 and 391.4 billion RMB. The expense for social community was 160.6 billion RMB, accounting for 52.6% of the total expense. Although not equivalent to Beijing and Shanghai, Chongqing can still be considered as sufficiently developed according to governmental budget as well as GDP per capita, in the context of national average level. Nevertheless, the deficit in Chongqing's budget could be said as great according to the national level. The rate of deficit to governmental expenditure was 42.14% in 2011; however the whole national scale was 5%. And such rate in Beijing and Shanghai are discriminately 7.4% and 12.4%. As the figures show, Chongqing's government is running a relatively greater deficit. Under current circumstances, the discrepancy between government revenue and expenditure could be covered by issuing public bonds. However, the local government could not issue the bonds itself and the issuing of local public bonds is the responsibility of the Ministry of Finance of the central government. The large budgetary deficit shows the progressive financial policy adopted in Chongqing for boosting the economy. As the city of Chongqing is lagging behind its peer cities, its government expands the total demand in the city by adding public expenditure. However, such policy may be too progressive to attain its expected outcome. Although public financing is one of the major instruments in leveling the economic development in China, for most of powers are under the charge of the local government and central government, the situation in Chongqing shows that such instrument has been overused. Compared with Shanghai, the deficit in Chongqing's budget is too high and it may arouse problems in inflation and crisis in government credit. A government burdened with heavy debts can not operate normally. To maintain a healthy and stable environment for development, Chongqing's government should reconsider its public policies and find out the cause of such great deficits in order to treat the deficits appropriately in the following years.

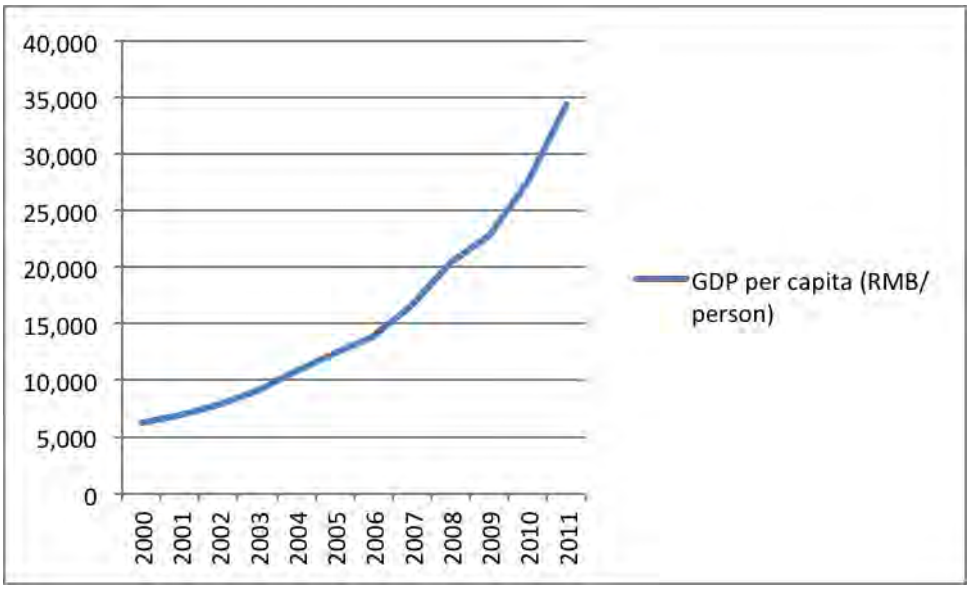


Fig. 3-4 GDP per Capita (2000-2011)

vii. Labor and employment

The employment distribution of Chongqing in three separate industries has changed greatly over the past decade. The number of people engaging in primary industry decreased rapidly and the figure for 2011 was 6.04 million. Meanwhile, the employment in the secondary tertiary industries has increased, as by the end of 2011 the number of people in the tertiary industry was 5.90 million, reaching the same level than those in the primary industry. The rapid change existing in different industries can reflect the process of urbanization to some extent. From a national scope, employment in the primary and secondary industries accounts for about 35 percent and 29.5 percent in 2011, while such two figures for Chongqing are respectively 38 percent and 24.7 percent. Both in Chongqing and nationally employment in the primary industry has declined during the past 5 years, indicating that Chongqing is now proceeding along the pace of the whole nation in urbanization, though the extent may not be as great as the national level. In Shanghai, people employed in the primary, second and tertiary industry accounted for .03%, 49.21% and 50.76%. While in Chongqing, such figures were 38%, 24.7% and 37.3%. The distribution of labor force is directly related to the structure of the economy. As Chongqing has a long way to catch up with Shanghai, the still great number of people involved in the first industry is not hard to explain. In addition, Chongqing has the largest area of rural region in the four directly controlled metropolis; the inland geographical location also explain the large employment in the primary industry.

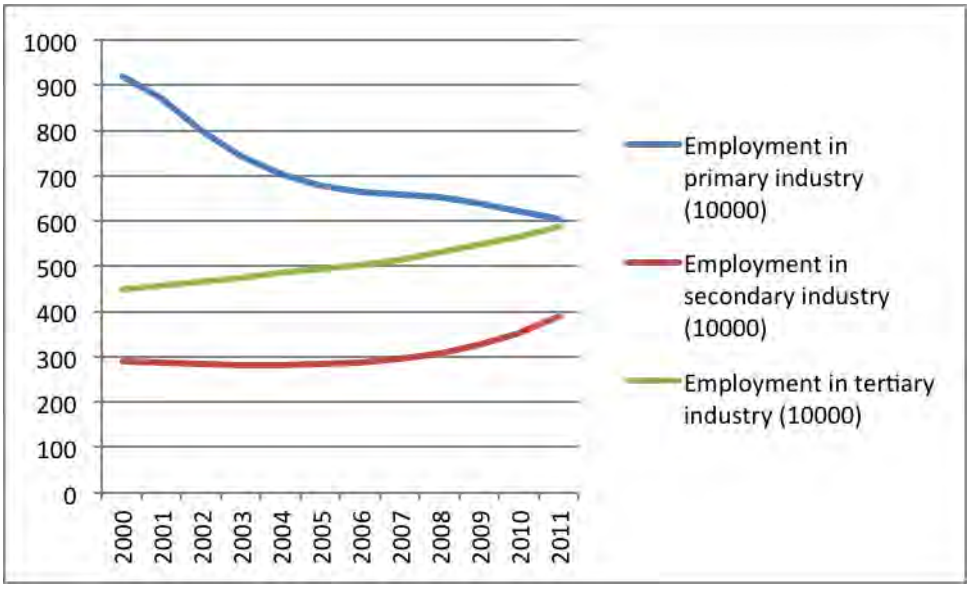


Fig. 3-5 The Changing Trends of the Three Industries' Employment

c. Ecological environment

viii. Natural resource endowments

There are rich vegetation resources in the territory of Chongqing, with forest coverage reaching 20.49 percent. More than 6,000 kinds of vegetation can be found in this area. And among the over 600 kinds of animal species found in Chongqing, 100 are rare animals that enjoy special protection of the State, including the golden-haired monkey, the South China tiger, the bee monkey, and the black stork.

Rivers and water systems crisscross the territory of Chongqing, and they have tremendous energy to be developed. While over 600 kilometers of the mainstream of the Yangtze River runs through the city, the river is joined by five major tributaries and over a hundred streams with the Yangtze as the axis. The city has 14.38 million kilowatts of water energy in theory, of which 7.5 million kilowatts can be developed - how? in what ways?. The potential installed gross capacity per square kilometer in Chongqing is three times the average of the country. This makes Chongqing one of the top cities in China in terms of hydroelectricity production.

Of the major cities in China, Chongqing is the richest in mineral resources. 75 kinds of minerals have been found, and 40 minerals have been proved to exist in 353 places, with a potential value of 388.2 billion RMB. Major sources of minerals in the city are coal, natural gas, manganese, mercury, aluminum, and strontium, among others.

ix. Air quality and pollution emissions

In 2012, the total industrial waste gas emission was 835.98 billion cubic meters with sulfur dioxide emissions of 0.51 million tons and industrial dusts and fume emissions of 0.166 million tons. All these three figures above have decreased by 8.3%, 4.0% and 3% respectively, with reference to 2011. Meanwhile, the volume of sulfur dioxide discharged in daily life decreased by 1.1%, but the volume of dust discharged from daily life was almost as much as three times the quantity of 2011. The percentage of high air quality days in downtown in 2012 was 92.9 while this percentage for 2011 was 88.8. Figure 3-6 indicates that the removal of main air pollutants, such as sulfur dioxide, industrial dust and soot generally increase through the decade. The municipality has been launching in the downtown area of the city in order to improve the air quality of the region. Also, the city has been introducing to promote the elimination of ineligible cars which do not meet the emission standard of the city and the national standard.

Particular measures have been taken to treat the air quality problem and preliminary results indicate that governments' efforts have paid. The city of Chongqing has still a great potential for protecting its atmosphere, as the total expenses on treatment of waste gas keep rising, having reached 0.27 billion RMB in 2012. Comparatively, Beijing and Shanghai have invested 247 and 555 million RMB respectively in the treatment of industrial waste gas pollution in 2012. Despite the rising expenses of treatment of waste gas, Chongqing invested? 165 million RMB, which was less than the peers. From air quality figures, the proportion of days of air quality equal to or above Grade II in the whole year of 2012 was 92.7% in Chongqing and 76.8% and 93.7% in Beijing and Shanghai. According to such indicator, Chongqing and Shanghai were both in the top ten of major cities of China. Chongqing is less developed than its peers, so the lower level of development could partly contribute to the better air quality in Chongqing, when compared to Beijing, which is suffering severe air pollution problems. Moreover, Chongqing's primary industry proportion is far greater than Beijing and Shanghai, so the city could create less harm to the air as the primary industry has limited effects on the atmosphere when compared to the other industries.

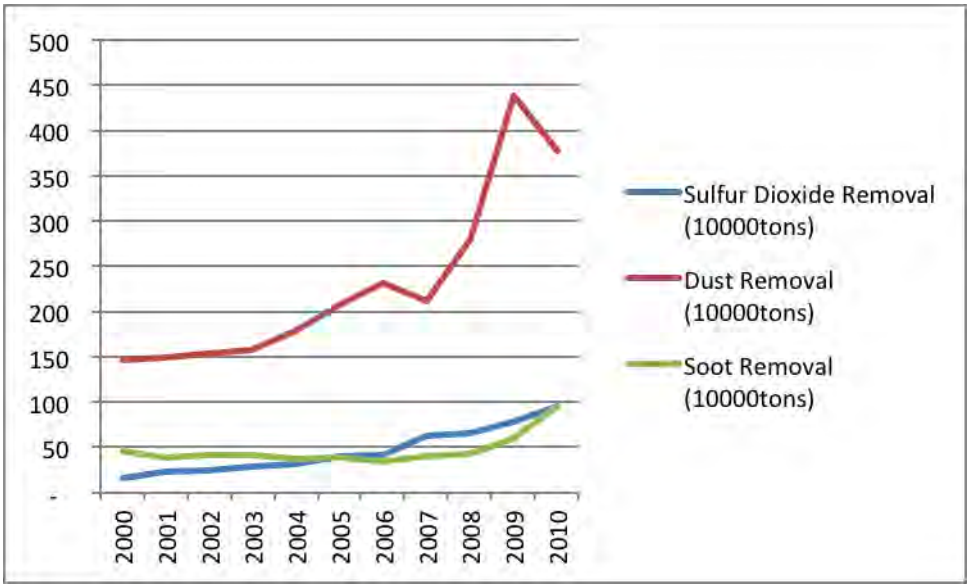


Fig. 3-6 Industrial Atmospheric Waste Pollutant Treatment

x. Water quality and pollution emissions

The total volume of industrial waste water discharged in Chongqing in 2012 was 0.306 billion tons, a decrease of 9.8% with relation to 2011. From figure 3-7, we can see that the volume of waste water discharged has been decreasing for the past years. The volume of domestic sewage discharged was 1.017 billion tons, an increased of 4.4%. The expenditure in treatment of industrial waste water decreased in 2012 by 21.1%. The investment completed in treating waste water in Chongqing in 2012 was 175 million RMB, with those numbers showing 30 million and 53 million in Beijing and Shanghai.

Chongqing's government has invested a lot in the treatment of industrial waste water when compared with its peers. The total waste water discharged was also less than Beijing and Shanghai. Chongqing is located in the upper reach of the Yangtze River and thus its environment is vital for the whole river: therefore the central government pays high attention to waste water treatment in Chongqing. Mandatory efforts, such as terminating unqualified small factories which cannot meet the water quality standard, could be implemented more effectively in Chongqing both by the local government and the central government. However, treatment systems for domestic sewage do not manage to follow the rapid pace of urban construction. As the process of urbanization contributes to the increasing of urban population and consumption of water, greater efforts in treatment of domestic sewage and waste water from daily use are still needed.

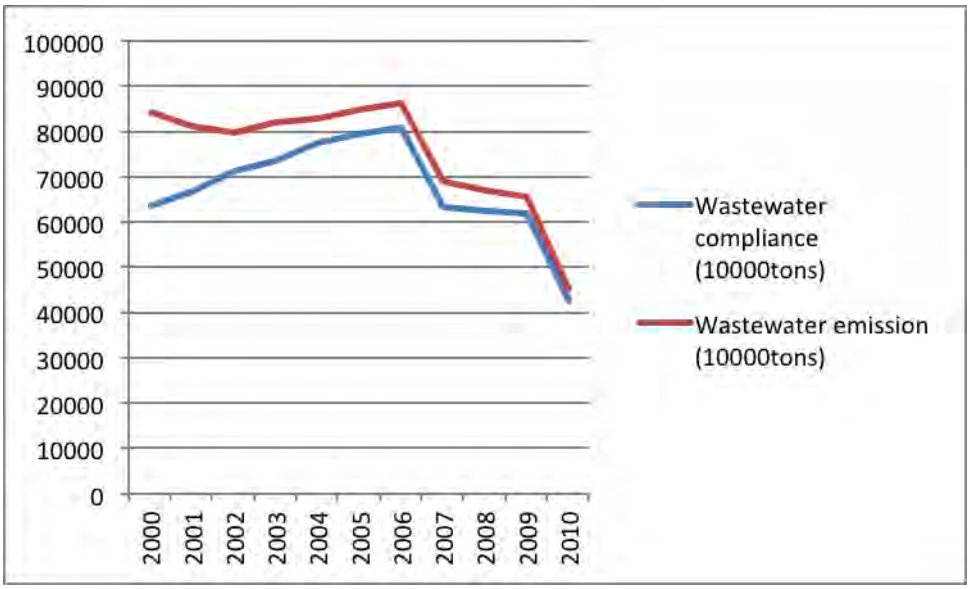


Fig. 3-7 Wastewater Pollutant Treatment

xi. Solid waste generation and emissions

The industrial solid waste produced in 2012 was 31.64 million tons with hazardous wastes of 0.49 million tons, a decreased of 5.4% in relation to which year?. The discharged volume of that had been produced was 50 thousand tons, decreased by 79.2%; the treated volume was 4.87 million tons, decreased by 13.3%; and the comprehensively utilized volume was 26.06 million tons, increased by 0.6%. The rate of comprehensive utilization was 81.56 in the year of 2012, increased by 6.1%. Figure 3-8 shows that both the production and utilization of solid wastes have been increasing simultaneously through the decade and the discharge of solid waste keeps falling slightly. There is a special organization, called the Municipal Solid Waste Management Agency, established in 2005. The agency focuses on supervising and managing the disposal of solid waste, hazard waste, medical solid waste, POPs, and ODS substances. The supervision is not only conducted in the sphere of industry, but the domestic disposal of solid waste is also under the oversight of the agency. However, the effect of government's efforts is qualified. The ratio of common industrial solid wastes comprehensively utilized in 2012 was 82% in Chongqing, and that figure in Shanghai was 97%. From the aspect of consumption wastes, the treatment capacity in Beijing and Shanghai were 16,380 and 11,732 tons per day respectively, while the situation in Chongqing was 8,154 tons per day. In fact, Chongqing's investment completed in treating industrial wastes was more than Beijing and Shanghai. However, the real condition in Chongqing is not better than Beijing and Shanghai. Technical issues in treating industrial wastes and the awareness of the public in appropriately treating consumption wastes could be regarded as the main elements for Chongqing's current condition. The polluting factories in Chongqing are greatly different from those in Beijing and Shanghai, for there are many chemical plants in Chongqing which create more hazardous wastes than ordinary factories. Factories with potential for emitting hazardous substances have been closed in Beijing and Shanghai, but in Chongqing, the case is different. Thus, in treating solid waste, Chongqing has to do a lot to change its structure of industry in order to tackle the problem thoroughly.

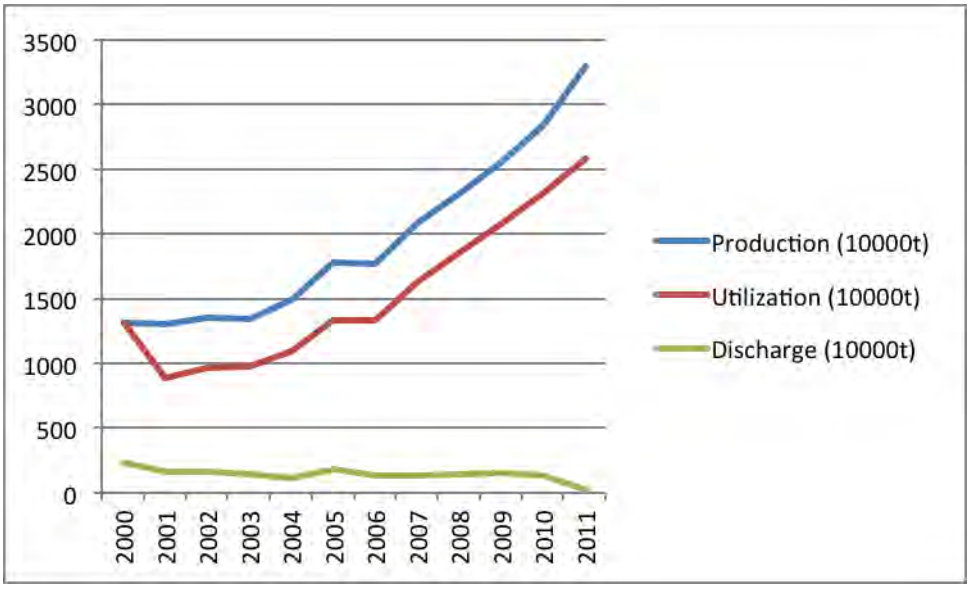


Fig. 3-8 Production and Utilization of Industrial Solid Waste

xii. Environmental pollution control facilities

The number of facilities for waste gas treatment in 2012 was 4,319 while in 2011 it was 4,134. The number of facilities for waste water control was 1,578 in 2012 and in 2011 it was 1,507. There were 111 on-going projects of industrial pollution treatment in 2012, while this number in 2011 was 253. The decrease in ongoing projects is due to the fact that many projects were completed by the end of 2011. During this period, 195 projects were completed in 2011 and 206in 2012. Completed investment in projects of industrial pollution treatment in 2011 and 2012 was respectively 0.73 billion and 0.64 billion RMB.

Capacity for treatment of industrial waste water in 2012 was 79.9 thousand tons per day and the number for 2011 was 85.7 thousand tons. The capacity for industrial waste gas treatment and solid waste treatment in 2012 were 5.1 million cubic meters per day and 450 tons per day, which show a decreased of 42.3% and 71.9% respectively. The decrease can be attributed to the decline in the discharge of industrial waste water. The total amount of industrial waste water has decreased rapidly through the past five years, as the figure in 2008 was 0.67 ton and that of 2012 was 45% the amount in 2008 with the number of 30611. Overall, Chongqing's investment in environmental protection was 2.03% of the GDP of 2012, while this percentage in Shanghai was 2.83% and the national level was 1.59%. So Chongqing is putting efforts in environment al protection and the endeavor is beyond the average level of China. Yet, there is still a lot to do to meet the standard that leading peer cities such as Shanghai have achieved in environment protection.

d. Energy systems

xiii. Energy classification

The distribution of major energy consumption for 2012 is shown on the figure below. As it indicates, electricity is the main form of energy consumption, accounting for over two thirds of the total energy used . Figure 3-10 shows that the consumption of energy has been rising in recent years.

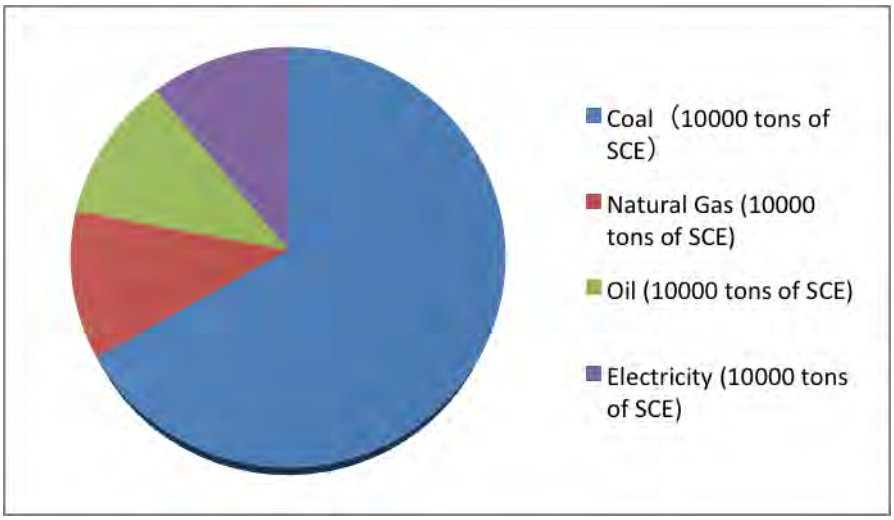


Fig. 3-9 The distribution of consumption of major kinds of energy 2012

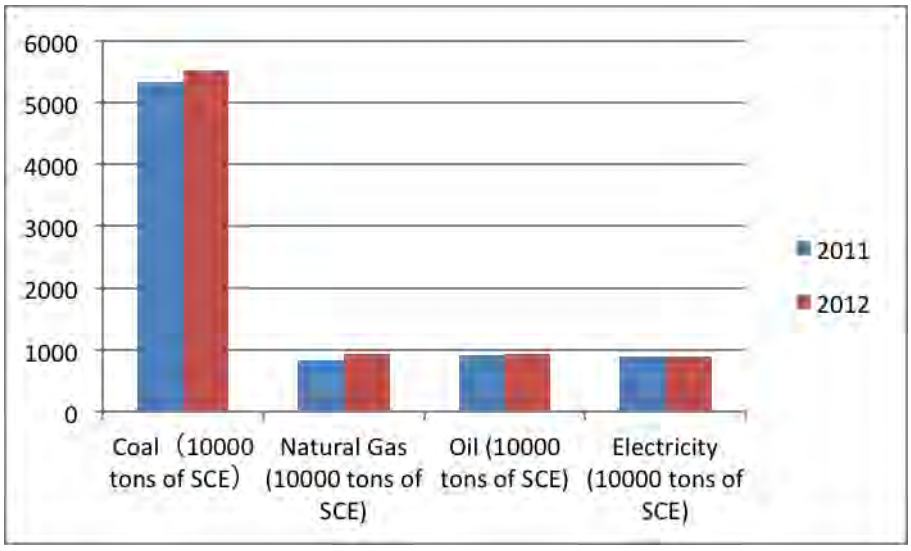


Fig. 3-10 Major Energy Consumption

xiv. Renewable Energy

The figure 3-11 shows the trends on total electricity production in Chongqing from 2000 to 2011. Production has obviously rised relatively rapidly through these years. At the same time, we can see from figure L (please clarify) that the use of hydro power and thermal power have grown from 2005 to 2012, with the growth of hydro power even more significant. Chongqing is located in a place with abundant hydro power, near the Three Gorges Dam. Thus, the better use of renewable energy such as hydroelectricity is vital to meet the needs of Chongqing's further expansion and urbanization. Chongqing is located on the margins of the Sichuan Basin and is always referred as the "Mountain City". It has limited wind resources. Also, there are no nuclear plants constructed in the area. The major and possibly the only renewable energy resource available is thus hydropower.

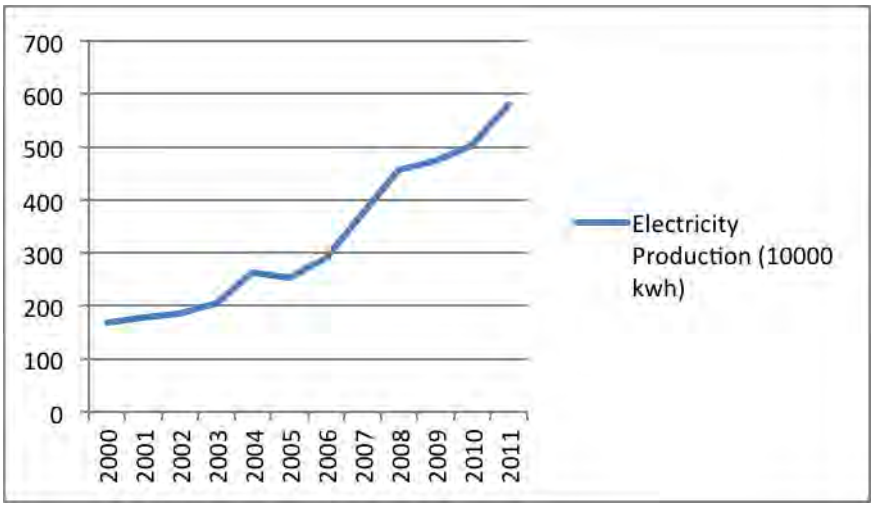


Fig. 3-11 Electricity Production

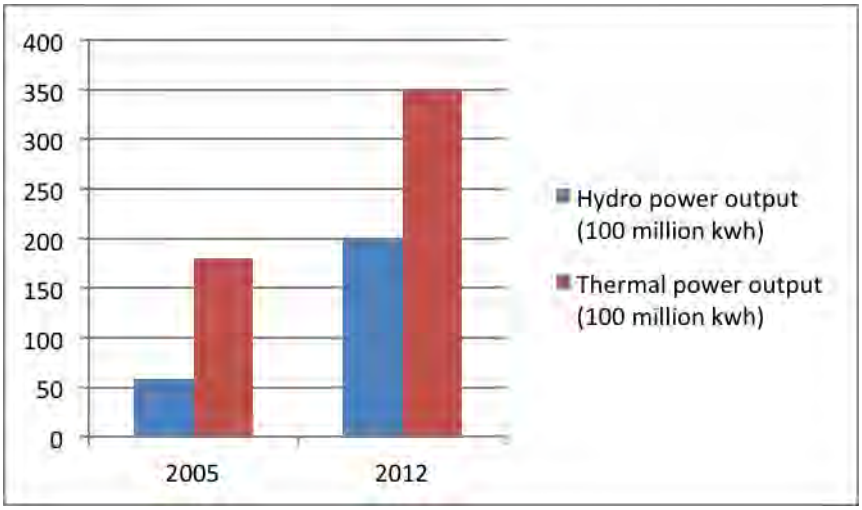


Fig. 3-12 Electricity Output

Other forms of renewable energy are not significant in Chongqing's energy structure, so there is no authoritatively available data about that for Chongqing.

xv. Primary energy consumption

as it can be seem on Figure 3-12 thermal power output is still dominant in electricity generation. Thus, the utilization of fossil fuels, especially coal, is vital towards the common requirement of the city. The consumption of coal was 55.21 million tons of SCE, 3.4% higher than that of 2011. Despite a significant utilization of hydropower in Chongqing, traditional use of coal still plays a prominent role in the city's total energy production .

e. Infrastructure

xvi. Built-up area status

The built-up area in Chongqing was 1,324.94 square kilometers in 2012.

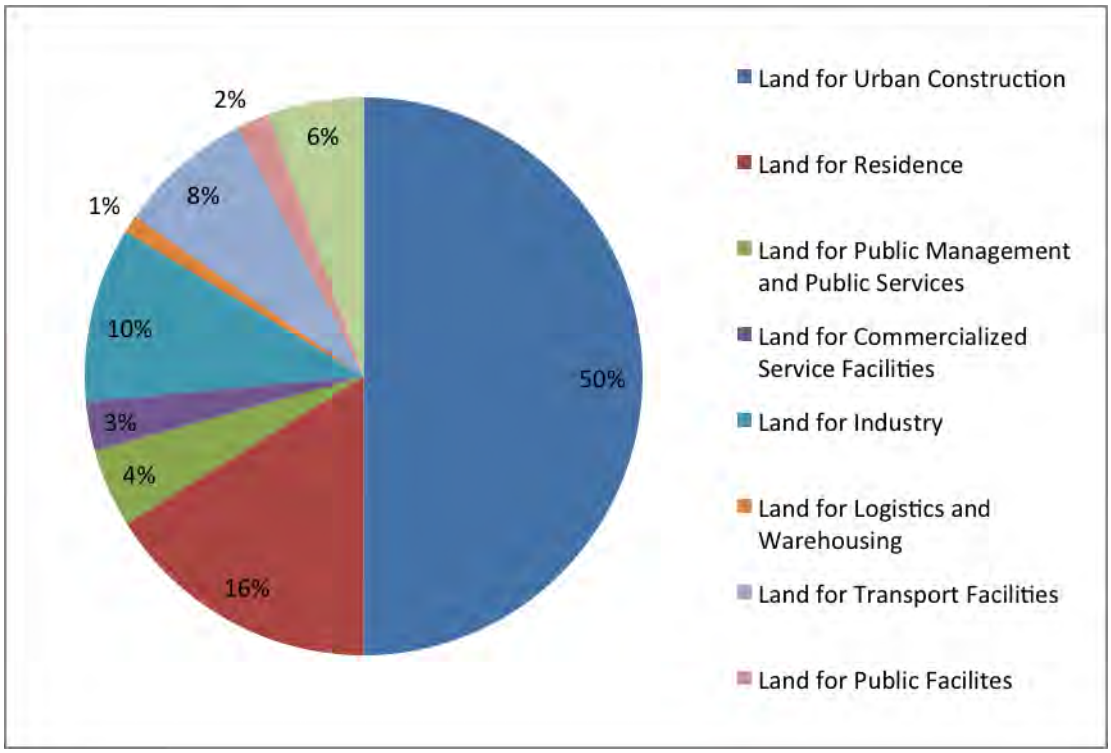


Fig. 3-13 Distribution of Built-up Area

On figure 3-13 we can see the distribution of the built-up area in Chongqing in 2012. The total use of land of Chongqing has been expanding through the past decade. Particularly, the area of green land has been increasing steadily over the past decade. Chongqing's increase in land uses meets the growing needs of urbanization. The area of green land in the city is adequate for building an environment-friendly metropolis. The ratio of area of built districts to urban area in Chongqing was 17.2% in 2012 and that of Beijing and Shanghai were 10.3% and 15.7%. However, regardless of the urban area, Chongqing's administrative area is approximately five times as great as that of Beijing and thirteen times as great as that of Shanghai. In addition, the population density of Chongqing's urban area was 1832 persons per square meters, while in Beijing this value was 1494 and in Shanghai 3754. In fact, Chongqing has the potential to broaden its urban area although its downtown is geographically surrounded by mountains. The obstacles for Chongqing to expand are relatively lesser than in Beijing or Shanghai, which have already reached their limit in using extra land for urbanization in their administrative regions.

xvii. Road conditions

The length of paved roads in 2012 was 7,660 kilometers and in 2011 it was 7.158 kilometers. The area of paved roads is 15,000 square kilometers in 2012 and in 2011 it was 13,934 square kilometers. The length and the area of paved roads in Beijing were respectively 7,894 kilometers and 135.09 square kilometers in 2012 and those figures for Shanghai were 4,775 and 97.17. Road construction could be referred as equivalent to Beijing and Shanghai. Road construction is always the main aspect of an expanding city, and as figures indicate, construction of new roads is increasing rapidly as the government spends most of its efforts and investment on building new roads. Therefore, careful plans for building and expanding roads are crucial throughout the process. Inappropriate plans may lead to the waste of public investment and contribute to domestic problems such as traffic jams and damage the quality of life due to increased pollution of car traffic. Chongqing's urbanization poses such concerns, just like other major Chinese cities do.

xviii. Public transport

At the end of 2012, the length of the Public Transport Network was 8.828 kilometers, while the number of public vehicles reached 7.982 and the passenger volume reached 17.6968 billion person-times. The length of light rail transit was 131 kilometers and passengers 0.23 billion person-times. The total number of taxis in the city was 19.108 units in 2012.

Chongqing's geography makes it difficult for the city to develop an underground transportation system; however Chongqing's light rail system has proven successful in solving the problem of mass public transport. The length of the light-rail transportation system in Chongqing (131 km) is far behind the 442 kilometers in Beijing or the 468 kilometers in Shanghai, but equivalent to the 139 kilometers in Tianjin. Given the rather difficult landscape of Chongqing, the development of light-rail transportation is essential . The inadequacy of public transport of Chongqing when compared to Beijing and Shanghai is still significantly great. Governmental input for public transportation in Chongqing should be continuously rising, so as to develop sufficient transportation capacity for the local residents.

xix. Intercity and international traffic

Chongqing enjoys convenient intercity transportation, as the Yangtze River and the Jialing River pass through the city, making it the logistics center in West China and the most active commercial center at the upper reaches of the Yangtze River. The market is oriented to the whole country, connecting cities along the Yangtze, and is very influential in southwest China. The annual retail sales income keeps growing. Chongqing's turnover volume of passenger traffic in 2012 was 77.5 billion person·kilometers, while that of Shanghai was 122.3 billion person·kilometers. Over 80 percent of the volume (of passengers? Of goods?) in Shanghai was covered by civil aviation, while in Chongqing over a half was accounted by highway transportation and civil aviation only covered about 20%. Shanghai has undoubtedly more advantages than Chongqing with regard to foreign passengers, as the city offering more diversity and opportunities. Chongqing, however, is a prosperous city in southwestern China and the major traffic is concentrated within the district. On the issue of bringing more people from other parts of China and around the world, Chongqing is still not comparable with Shanghai. It is currently a regional transport center, not an international one.

Residential

Total residential buildings in 2012 amounted to a total of 51.74 million square meters of construction. Residential buildings that were completed in the year were 33.86 million square meters. 41 million square meters of residential buildings were sold and the sales for those buildings represented 197.24 billion RMB. The average price of residential houses in Chongqing was 4,492 RMB in 2011, compared to 15,518 in Beijing and 13,566 in Shanghai. Chongqing's price remains low and has thus the potential for further increase. The price of houses is the primary indicator of the living cost of the city. Current low prices in Chongqing suggest the favorable condition of the city for attracting more people from rural areas or other underdeveloped areas who cannot afford the high prices of Shanghai or Beijing. However, if the price keeps increasing, the problems derived of high living costs might happen in Chongqing as well.

3.3 Analysis and Conclusion

a. Chongqing: Development potential and dilemmas

Chongqing is one of the four direct-controlled municipalities and the only one of its kind that locates in the western part of China. Nowadays, Chongqing is facing the omnipresent benefits and challenge from rapid urbanization as other major city has been experiencing.

In contrast with other big cities in various parts of China Chongqing has its unique potential in launching particular plan of urbanization. **1)** It has the superiority in gaining central government's support, especially financial support, within the western area of China, and it has already

experienced the rapid growth in economy since the establishing of the direct-controlled city since 1997. In addition, superiority lies in attracting foreign investment compared with other western cities. **2)** With the boost in economy, Chongqing becomes popular in attracting workforce not only from its administrative area but also from other provinces in the western district of China. The growth of population accompanies with the growth in jobs offered there. Also, the cost of living in Chongqing is relatively low in contrast with Shanghai or Beijing, which makes the city a more available choice to people around the city. **3)** Meanwhile, the infrastructure of Chongqing has been well constructed for 15 years, with adequate public transportation, especially the light rail transits, and residential condition. The level of resident's living standard is steadily rising through this period and the price of residential buildings is also rising through the time, though in average, prices of houses are still not comparable with that of other three direct-controlled municipalities**4)** The Three Gorges Dam is located in the east to Chongqing and such a project is the sufficient energy backup for Chongqing, but the existence of the project also has impact on the ecological system of Chongqing. The natural sources, especial minerals and hydro power, are abundant in Chongqing and could become the advantage for its development. **5)** From environmental perspective, Chongqing has been conducting special projects and measures in treatment of industrial pollutants. The quantity of emission of waste air, water and solid substances are shrinking tremendously during the last decade. The reduction in industrial contamination necessarily backs up the urbanization of the city. **6)** There still exists sufficient land for further expansion of the city and the potential construction for the next decade could be carried on without much geographical limitation.

Despite of all those potentials mentioned above, dilemmas still exist in the development process of Chongqing. **1)** The urbanization of Chongqing has boosted the population of the downtown area of the city. As more people are accumulated in the city, the municipality will be more burdened by the population. The daily emission of sewage is rising and the environment is experiencing the pressure created by the social modernization. **2)** The deficit which the city is running is excessively high according to the income of the government. High level of debt of the government may contribute to deep social and economic problems such as inflation and crisis in governmental credits, which are not phenomena for steady growing. **3)** The government of Chongqing has concentrated on the control on industrial wastes including waste gas emission, treatment of waste water and waste solid. However, concentration is also needed in the control over the daily public sphere such as the domestic sewage. Furthermore, the use of renewable energy is vital towards sustainable development. **4)** Furthermore, similar with phenomenon appeared in other main cities in China, Chongqing is also experiencing over construction in buildings, roads and other forms of infrastructure. Some constructions are not conducted under discreet municipal plans, creating problems of excessive simultaneous projects which disrupt the life pattern of residents. Problems in the waste of resources, both in raw materials and energy, are aroused as well.**5)** The city is sprawling through the process of urbanization; therefore the energy consumption should not be only largely depended on the thermal power by burning coal. The proportion of hydro power in the total generating capacity should be raised in order to guarantee the sustainability and environmental-friendliness. **6)** Through the utilization of hydropower, however, the ecological condition of the three gorges area arouses major concern from both the academic and public spheres. The establishment of the dam has greatly changed the geological structure of the region, thus the relatively frail ecosystem has experienced damages to some extent. The problem with the ecosystem should not be ignored when people are enjoying greater output in electricity generation.

b. Chongqing development model and trends of sustainable urbanization

Chongqing's sustainable development model should be based on the basis of better utilization of its regional and indigenous advantages. **1)** On economic aspect, the current model of growth is similar to those other big cities in China—government investment promoting the demand of the whole social community. As the government is in charge of the most affairs of most of the spheres of the society, it should also play important role in maintaining the balance and upholding the social

welfare. The infrastructure construction should be continuing to meet the requirement of the increasing population. The market should be open to foreign investment as well. Controlling the expenditure of the government is also of equivalent importance. The budget should be balanced as planned and expected with deficit at proper level. **2)** As investment flows enter the city of Chongqing, more projects will create more jobs in the city and subsequently the upcoming workforce will be greater. **3)** The land use of urban area could be expanded with careful plans and projects to fully utilize the resources. **4)** The control and treatment on industrial waste gas, waste water and waste solid should be kept carrying on under rigid regulation. It is also essential to set improvement in the control over emission from daily social part. **5)** The energy structure can be further optimized by advancing utilization of renewable energy. The ultimate purpose is to maintain the sustainability under the pressure of urbanization and create a municipality meeting the need for the process. Trends in sustainable urbanization also lie in various aspects above. The total economy will keep growing with large quantity of financial support flowing to the city. Urban population will still rise at the same time. The treatment in industrial wastes will remain at the current level. Energy consumption can be considered as sufficient in the foreseeable future. Continuous pressure from the growing number of urban population and urban constructions will be fatal element in hampering the city obtaining appropriate environmental quality.

4 Kunming

4.1 Introduction

Kunming is located in southern China. Downtown of the city is in the north of Dian Chi basin, south Dian Chi is surrounded by mountains on three sides. The terrain of Kunming is lower from north to south. Most area is between 1500-2800 meters above sea level. The highest elevation is 4247 meters and the lowest elevation is 746 meters, while the average elevation is 1894 meters.

4.2 Kunming Urbanization – Current Situation

a. Society

i. Population

By the end of 2011, the total population of Kunming was 6,439,200 people, including 2,735,000 urban residents and 3,704,200 rural residents. Fig-4.1 shows the population change in Kunming over ten years. According to the statistics, Kunming 's urbanization developed steadily over the past few years, from 30.8% in 2000 to 42.5% in 2011.Kunming employs a relatively liberal policy toward immigrants which my account for its increasing population. According to the “Regulation on Floating Population of Kunming (2005)”, floating population need to apply for their children’s entrances to schools and the permanent residences of their current city as required. They can enjoy the same treatment as residents once the registration is completed normally (– this meaning?...). This increase in urbanization is largely attributed to a weaker government-controlled residential registration in recent years, which makes it is easier for rural residents to obtain an urban registration status.

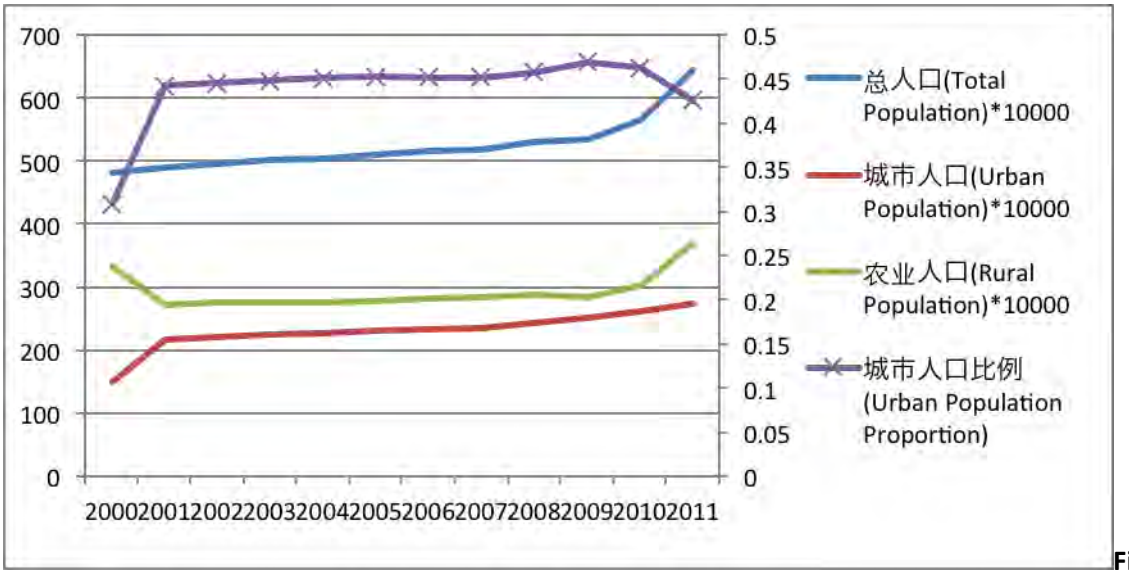


Fig. 4-1 Kunming 2000-2011 Population Structure

ii. Education

Kunming has boasted 40 regular higher educational institutions by 2011 and admitted 341.3 thousand college students in the whole year. The city has 21.7 thousand full-time teachers in colleges and universities. Meanwhile, the government has paid much attention to education, and in the fiscal budget science expenses accounted for 39.3 thousand RMB and educational expenses accounted for 278.4 thousand RMB. Based on the new requirements and challenges raised by the policy of “Education first and strengthen the national human resources”, one of the targets from the Seventeenth Congress of the CPC, Kunming will continue to increase the input into education and seek to improve the allocation of educational resources . In addition, Kunming will accelerate the construction of reform and development model schools, basic capability building and training bases

construction of secondary vocational education, boost with great effort the merging between vocational education and industries and boost the cooperation between school and enterprise. Fig-4.2 shows the expenses on science and education and the number of colleges and universities as well as the students and teachers.

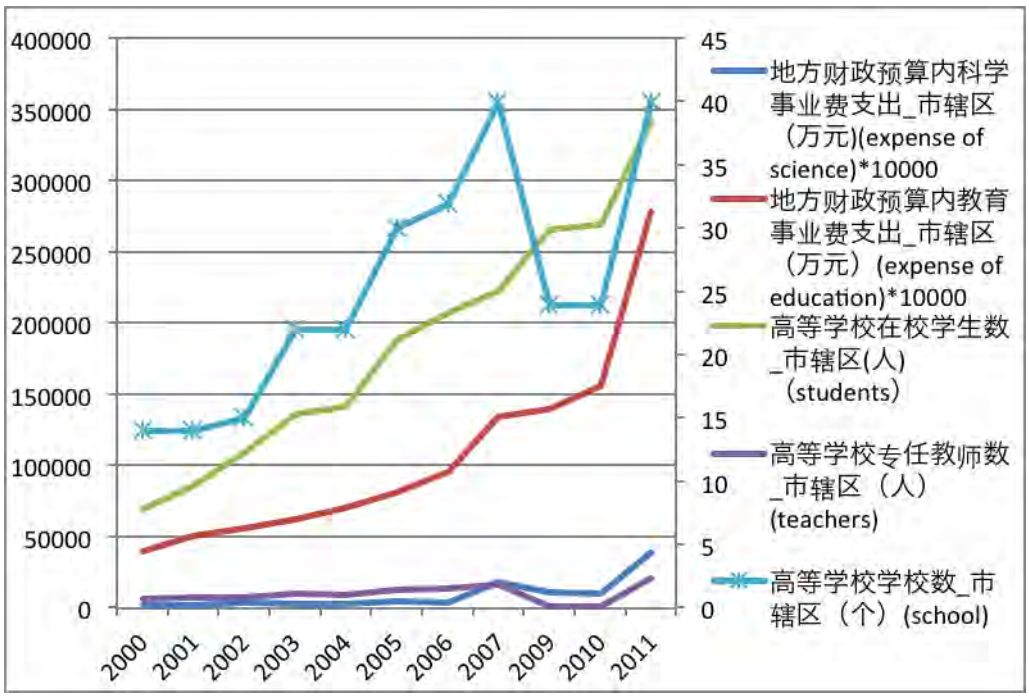


Fig. 4-2 Expense on science and education

iii. Culture

Since the 1990s, Kunming has positively boosted its cultural infrastructure. The city has developed cultural resources such as museums, libraries, theatres, exhibition buildings, science and technology museums. By the end of 2011, the city boasted 38 theatres of city-level and district (county)-level. Compared to the 109 museums in Shanghai, we may say there is a huge gap between the two cities. There are 16 public libraries in Kunming, compared to 25 in Shanghai, and 2,379.600 books in public libraries. . This means that 430 thousand persons share one library, and there are 31 books per one hundred people (while the average in China is 44). Availability of museums has increased from 16 per one million people to 30 per one million people. The performance increased from 334 to 1,000 per million people. Per capita spending in education, culture and entertainment increased from 999.2 RMB to 2,500 RMB, the average in China being 1,102 RMB. In addition, the coverage rate of public welfare physical fitness increased from 14% to full coverage (100%), and per capita availability of public sport facility area increased from 1.08 m^2 to 2.5 m^2. The imbalance of basic cultural service in Kunming is still large between urban and rural, the input in the field is insufficient for long term with long history and social requirement cannot be met. In rural areas, the public cultural service is lagging behind. In different places, the gap in public cultural service is wider than that in economy. In rural low income families and social group in difficulties, their rights to obtain basic public cultural service cannot be fully guaranteed.

iv. Health and Hygiene

As of 2011, Kunming had 323 formal hospitals, including a center for disease control and a maternity and child care center, with a total of 26,165 beds. In addition, Kunming has about 100 smaller hospitals or polyclinics that can satisfy residents' basic needs for common medical service. In Shanghai there are 317 formal hospitals, with a total of 54.2 thousand doctors and 109.6 thousand beds. Because of their limited medical equipment and technology, patients in Kunming hospitals are mostly elderly people and those who sufferer from chronic diseases. At the same time, it is worthy

of noting the considerably healthy quality of life that the elderly lead, with little concern about bedridden illness at ages well past-retirement. Following Fig-4.3 shows the development of hospitals from 2000 to 2011.

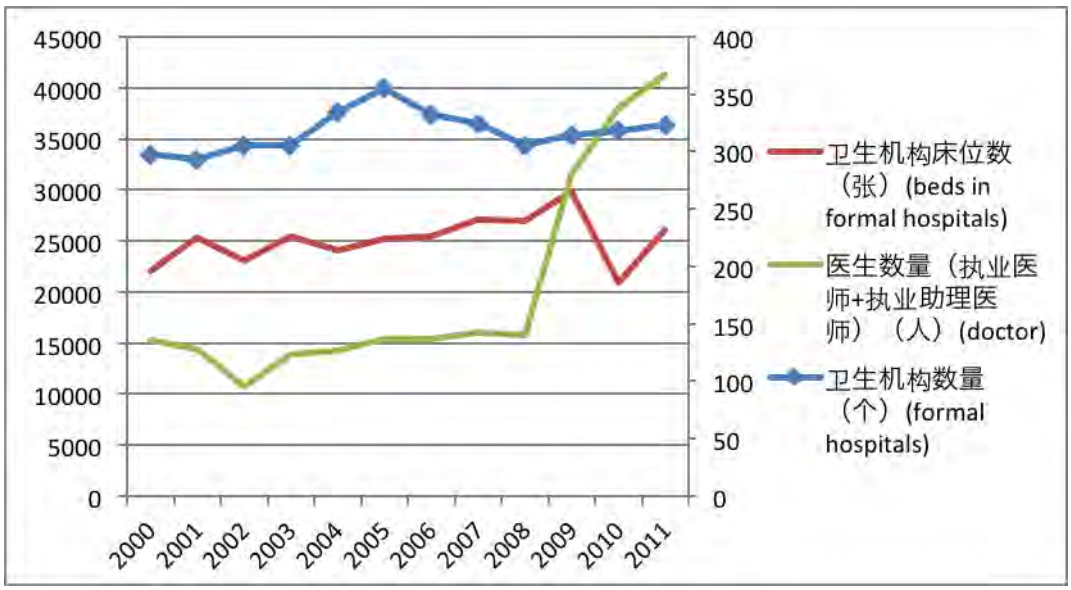


Fig. 4-3 Development of hospitals from 2000 to 2011

v. Social insurance and social assistance

In terms of minimum living standards, residents received allowances of 356,180,000 RMB as expenditure for pensions and relief funds for social welfare in 2006. At the same time 918,440,000 RMB of minimum living allowance were given as subsidies for social security. In 2013 the minimum living allowance was 680 RMB per month, while in Beijing this value is 580 RMB. A living allowance higher than Beijing and Shanghai seems to be unreasonable, but until now there has not been any official explanation for the fact. The minimum wage was 1,265RMB per month in 2013, while it was 1,400RMB in Beijing. Although Kunming pays lower minimum wages than Beijing, the cost of living is lower, especially for housing. In total, the amount that the government distributed to these individuals in 2013 was 1,274,620,000 RMB. The rural social security in Kunming is lagging behind: Kunming has started in 2007 pilot projects for basic endowment insurance for people whose land was acquisitioned in Wuhua District, Chenggong County and Fumin County, but the result has not been auspicious: there are just a few insured peasants, and many lost their lands with a promise of getting insurance but are still waiting.

a. Economy

i. Industrial structure

Of 2011's 251 billion RMB GDP, primary industry contributed 1.33 million RMB (with a decrease of 7.7% from 2010); the secondary industry generated 11.6 million RMB (an increase of 2.2%); and the tertiary industry raised 12.1 billion RMB (a decrease of 1.2%). The proportion of the three industries is 5.3, 46.3 and 48.4. Secondary and tertiary industries add up to 94.7% of the total GDP (a 0.4% increase from the year before). Within the next 5 years, Kunming's industrial structure will continually undergo changes by gradually increasing ratio of industries. -which industries?

Fig. 4.4 shows the different industry's growth data from 2000 to 2011.

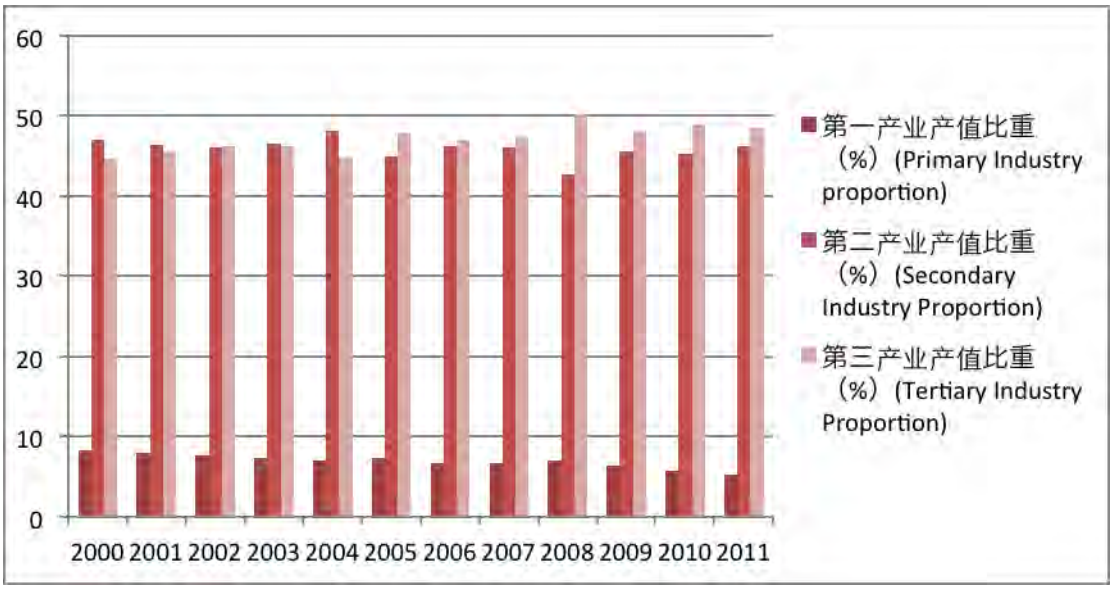


Fig. 4-4 Different industry's change from 2000 to 2011

ii. Government revenues and expenses, GDP per capita data

In 2011 Kunming's GDP reached 250.96 billion RMB (an increase of 18.4% from the previous year). Per capita GDP reached 38,831 RMB (an increase of 5,282 RMB from 2010). (Fig. 4-5). From 2000 to 2011, both fiscal revenue and expenditure showed trends of rapid growth, though fiscal revenue's growth was faster than expenditure growth (Fig. 4-6). In 2011, Kunming's year-end fiscal revenue was 31,768,930,000 RMB, a 25.2% increase from the year before, and fiscal expense was 44,173,220,000 RMB, a 27.6% increase. The GDP is rising year after year, therefore the population's quality of life is improving. According to the universal law of urban development, as the passage of economic development phases, the industrial focus first shift from primary industry to secondary industry, then to tertiary industry. Within the next 5 years, Kunming's industrial structure will continually undergo structural changes by the gradually increasing ratio of industries -which industries?

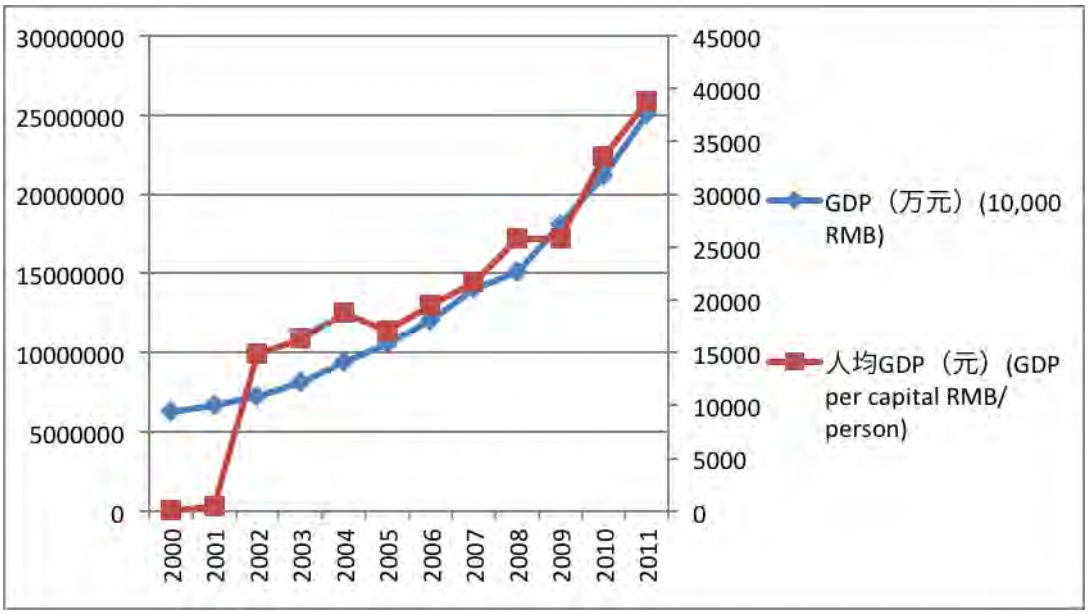


Fig. 4-5 The Economic Development Data of Kunming2000-2011

Fig. 4-6 The fiscal budget

iii. Labor and employment

At the end of 2011, there were 985,500 people on the workforce, an increase of 23,000, with an average salary of 39,401.93 RMB, less than the previous year. The year-end unemployment was 19,732, meaning an unemployment rate of 2.0%. In 2011, the entire district had 689,400 employees, 37,000 people more than the year before. Primary industry had 2,900 people, 100 fewer than the previous year; secondary industry had 280,700 people, 1700 more; and tertiary industry had 405,800 people, 35,400 more.

Fig. 4-7 reports the three-industry employment data for 2003-2011. According to the graph, employment in secondary and tertiary industries shows an upward trend. The increasing employment in secondary industry illustrates the continually rapid development of Kunming's heavy industry. The number of employees in tertiary industry has significantly increased. This is due in part to the government paying greater attention to the environment as well as economic development.

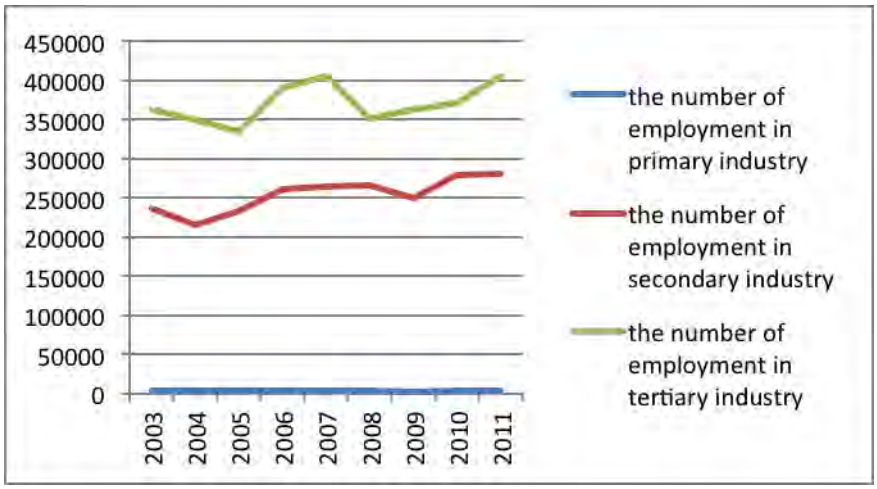


Fig. 4-7 The number of employment in different industry

b. Ecological environment

i. Natural resource endowments

According to the 2011 survey data on Land Use Change in Kunming, the total land area is 2,101,254 hectares. Agricultural land is 164,000 hectares, or 78.1% of the total land; building land is 29,800 hectares; green land is 11,932 hectares. Although Kunming has the Dianchi Lake with a

drainage area of 2,920 square km, a water surface area of 300 square km, and a volume of 1.29 billion cubic meters...? Among the 14 cities with serious water resource shortage in China, Kunming's per capita water occupancy volume is even lower than those Beijing, Tianjin, Tangshan, being at the very low level. It is estimated that at present annual per capita water resource occupancy volume in Dianchi Lake basin is only 212 m3, equal to 9.6% of national average level. Take Anning City of Kunming as an example, the city has 265.5 thousand total population with census register, but the average runoff amount of surface water for years is 263 million m3, and annual per capita occupancy of surface water resource is 982 m3. Its annual per capita water resource volume is far below the national average of 2,200 m3, and only a little over the internationally recognized warning line of 700 m3.

ii. Air quality and pollution emissions

There is not a single day below Grade II. Although from this we may draw the conclusion that Kunming's air quality generally has reached standard, severe air pollution still exists. Air pollutant results mainly from industry and the residential sector. In 2010, industrial waste gas emission totaled 2.31 billion tons, (less 0.3% than previous year). In addition, industrial discharge of SO2 totaled 88,337 tons, smoke dust totaled 7,504 tons, and dust totaled 5,563 tons (down by 5.3%, 29.7% and 38.8% respectively from the previous year). Meanwhile, SO2 and smoke dust discharge from the residential sector has reduced obviously. The indexes of air pollution show a downward trend, which is due to the reduction of emissions promoted by projects "Blue Sky" and the "Colorful Yunnan Province plan" of the 11th Five-Year Plan. The figures below show the change in industrial gaseous pollutants in 2000-2010 (Fig. 4-8) and the change in gaseous pollutants in life in 2003-2010 (Fig. 4-9)

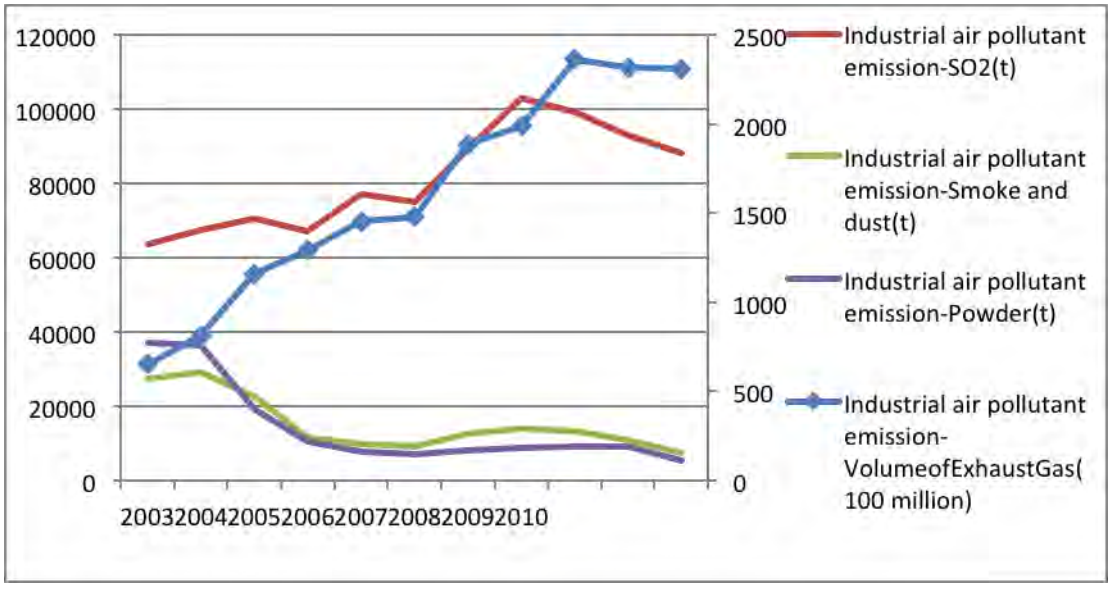


Fig. 4-8 Industrial gaseous pollutants in 2000~2011

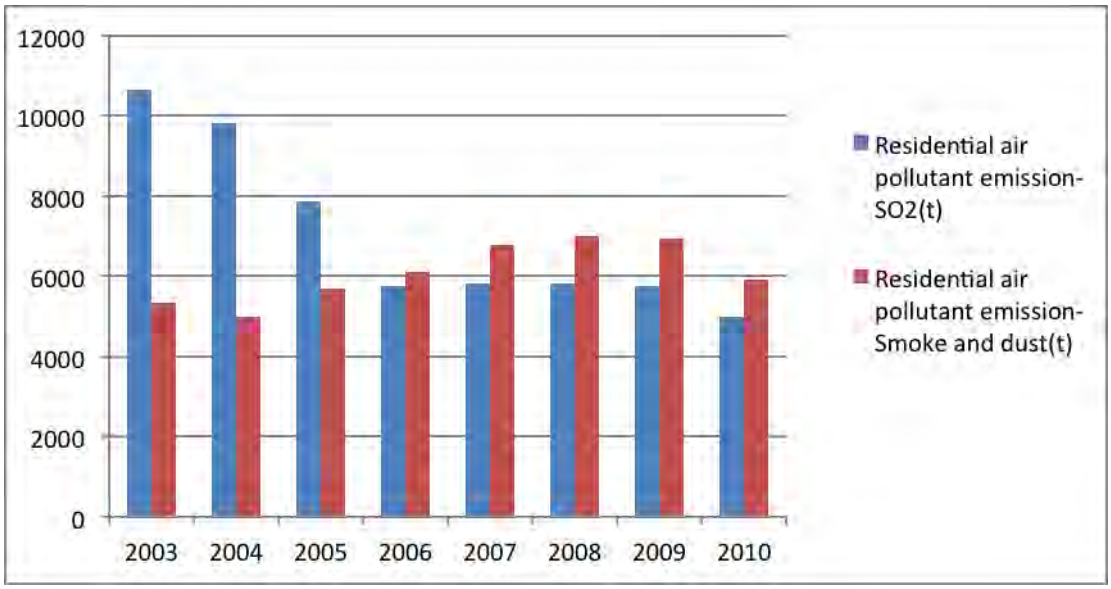


Fig. 4-9 Gaseous pollutants in life in 2003~2010

iii. Water quality and pollution emissions

Based on data from 2000 to 2011, the water quality in Kunming is improving. The volume of industrial sewage decreased from 82 million tons in 1999 to 32.25 million tons in 2011. However, urban sewage discharge increased to 254.6 million tons in 2009, from ...?. The disposal rate of urban sewage increased from 79.94% in 2009 to 91.7% in 2011. Fig. 4-10 shows the data on industrial sewage discharge.

Dianchi is a major water source of Kunming, and the water pollution is one of the important indicators of water quality. Dianchi is composed of two parts, the Waihai and the Caohai. Currently, the composite nutritional index of Caohai is 76.1, which indicates that Caohai is suffering severe eutrophication. Local areas of Caohai are becoming swamps and the water quality has decreased to levels worse than Grade V. The composite nutritional index for Waihai is 62.5, which belongs to the mesotrophication level. The water quality of the whole lake is worse than Grade V. Nine out of the thirteen rivers whose water quality parameters – chemical oxygen demand (COD), total nitrogen (TN), and total phosphorous (TP) – have been measured, meet the COD requirement (what about the others requirements?). The standard is met by 69%. However, the water quality for the whole Dianchi Lake Basin is still worse than Grade V. With respect to management, the increase of pollutants has slowed from 2000 to 2009. Domestic pollution is the biggest contributor to the pollution on Dianchi Lake basin. The industrial pollution sources have been controlled successfully. Moreover, the emission of non-point source pollutants has an upward trend.

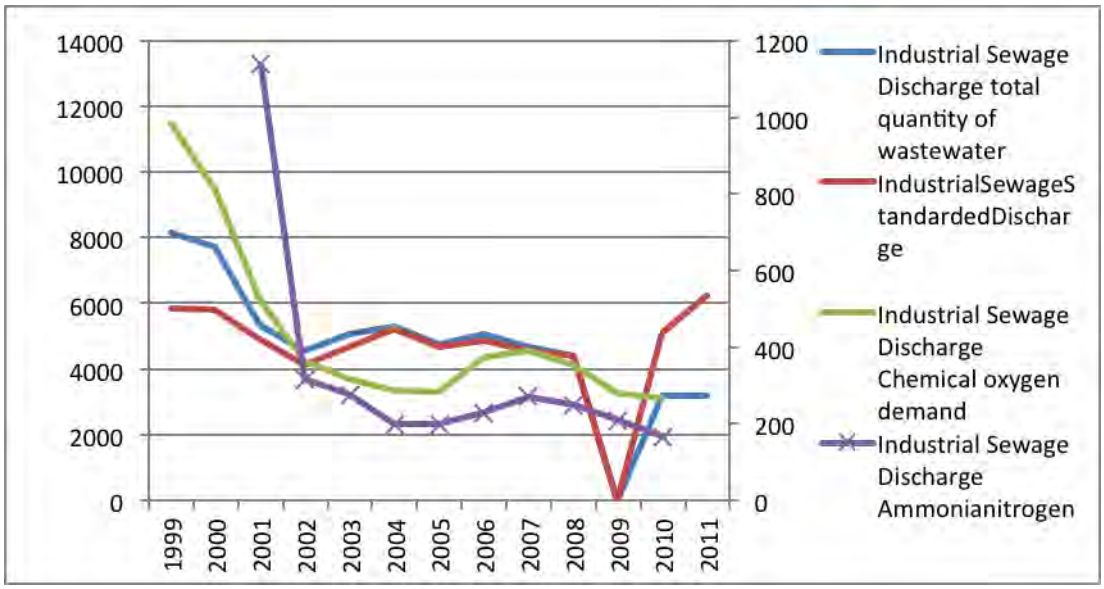


Fig. 4-10 Industrial Sewage Situation

iv. Solid waste generation and emissions

In 2011, Kunming industrial solid waste production was 38.63 million tons, an increase of 0.22% from the previous year. While industrial solid wastes utilization is 146.65 million tons, the comprehensive (? Please clarify this idea) utilization rate of industrial solid waste is 72.23%. The urban residential solid waste production is 1,021,800 tons, an increase of 89,900 tons from 2010. The high solid waste treatment efficiency is resulted from a signed framework agreement between Kunming municipal government and a private environmental-protection (green) company since 2009. This framework agreement has promoted a major reform of urban residential refuse treatment, from government arrangement to privatization operation. Such transformation gradually realizes the reutilization of urban residential refuse. In addition, the government made a policy called “PPP”, which make all companies take good care of the management of industrial solid waste

v. Environmental pollution control facilities

Waste water treatment facilities operation cost was 207.82 million RMB, and there were 12 sewage treatment plants in 2009. To control the severe Dianchi water quality pollution, during the “Twelfth Five-Year Plan” the government will invest 42 billion RMB (approximately USD 7 billion) in 101 construction projects. By 2015, the local government aims to improve the overall water quality, to reachGrade V. As for the waste gas treatment, desulfurization facilities in operation costs were 285.83 million RMB in 2011, or 38.1% of the total investment in pollution control. Following Fig. 4-11 shows the pollution control facilities change in recent years.

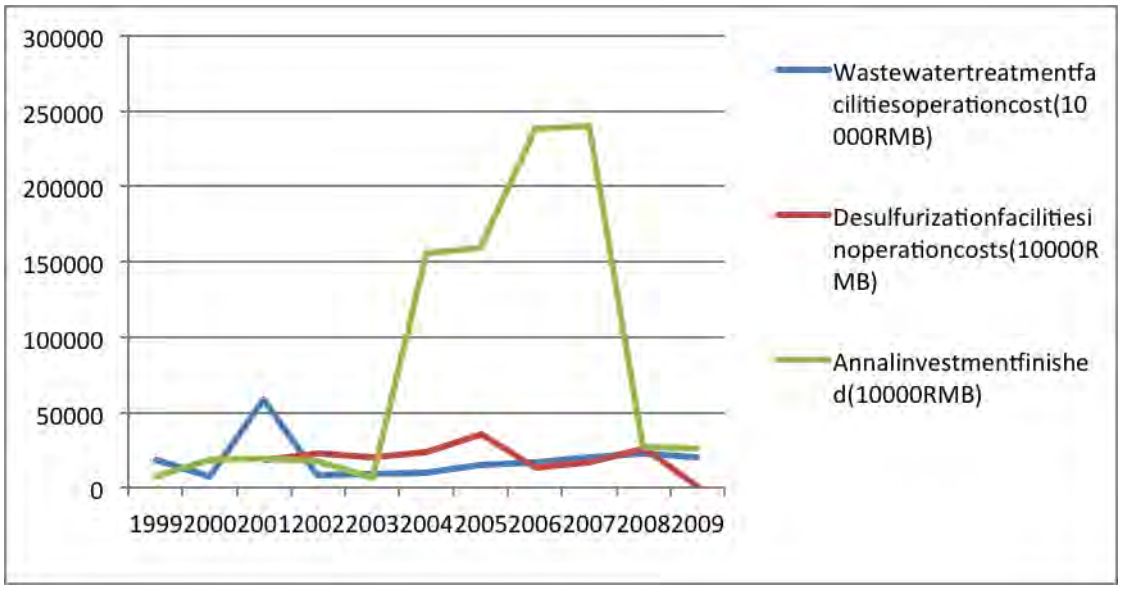


Fig. 4-11 Pollution control facilities

c. Energy systems

i. Renewable Energy

Production and consumption of renewable energy in Kunming is high. In 2011 Kunming water reserves reached 403,490,000 tons, with 87.73% of available hydro energy resources already being used. The amount of reuse is 251.92 million m^3. In addition, Kunming municipal government has made corresponding policy on renewable energy construction, issuing "On Kunming building Construction Renewable Energy Application Demonstration City Implementation Plan". The "Plan" explicitly states that Kunming will exploit solar, air source and shallow geothermal energy resources, industrial and technological advantages to the full, aiming to reach more than 40% of reutilization of renewable energy within the next 2~3 years. Up to 2011, solar building covered 6 million square meters. In 2012, Kunming completed another 3 million square meters of solar building. Kunming uses a higher level of renewable energy compared to other Chinese cities due to its hydropower resources. The development of renewable energy in Kunming is consistent with the standards and contents of two phases: comprehensive promotion (2011~2015), and consolidation and improvement (2016~2020) mentioned in "Suggestion on Low-carbon Kunming Construction" by CPC Kunming Municipal Committee and Kunming Municipal People's government.- Comprehensive promotion phase: by 2015, energy consumption per unit GDP falls to 1.011 tons of standard coal (in terms of 2005 comparable calculation). Renewable energy shares more than 10% of the total energy consumption. Consolidation and improvement phase: by 2020, energy consumption per unit GDP declines to 0.882 tons of standard coal (in terms of 2005 comparable calculation). Renewable energy shares more than 15% of the total energy consumption.

ii. Primary energy consumption

The average world annual energy demand growth is at a rate of 1.6%. Kunming's energy consumption is also increasing every year, most of which is the fossil energy consumption. Fossil energy accounts for about 85% of total energy consumption, which consists the petroleum (oil) accounted for 30%, coal accounted for 29%, and natural gas accounted for 22%. Meanwhile, renewable energy now experiences arrested development. The existing technical discovery process of renewable energy consumes more resources than renewable energy could save. Therefore, in order to explore renewable energy, government ought to continuously develop and improve technology.

d. Infrastructure

i. Built-up area status

According to Kunming land use change data in recent years, Fig. 4-12 below shows how the land is split for building, agricultural and greenland purposes. However, from the aspects of transportation and real estate, land use rate in Kunming is low with irrational land use structure. As the result of inconsequence industrial distribution, the urban land use structure will affect negatively the city operation efficiency and other main functions. Thus, the government needs to redesign urban structure scientifically, premising on intensive land utilization.

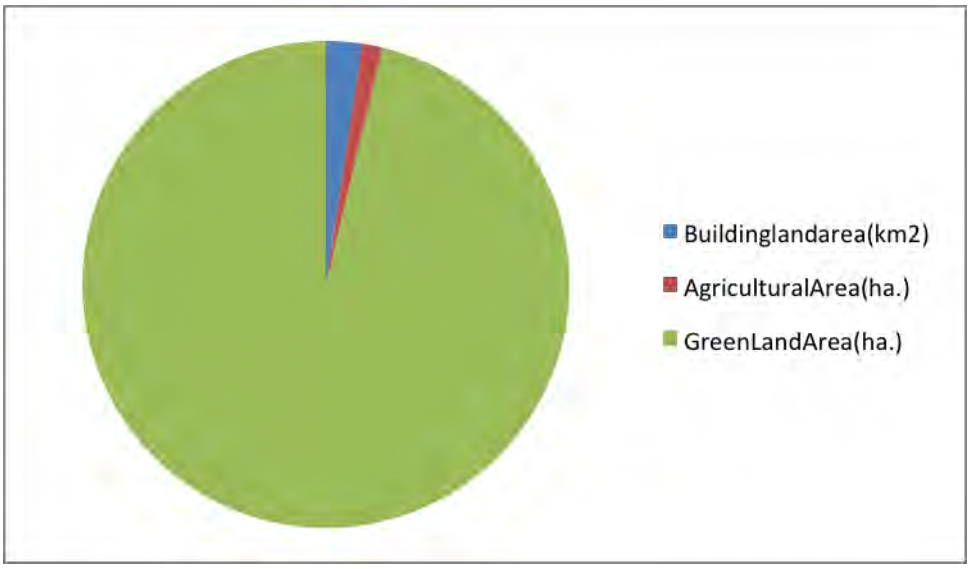


Fig. 4-12 Built-up Land Use of Kunming 2011

ii. Road conditions

Between 2002 and 2010, Kunming's area of paved roads increased by more than 223.4%, from 10,090,000 m^2 to 32,630,000 m^2. Although such amount of road construction is supposed to minimize recent traffic problems, the number of roads is still not significant enough for the city to build parking lots at shopping centers etc., therefore parking is usually made along on the road, which causes frequent traffic jams. (Fig. 4-13)

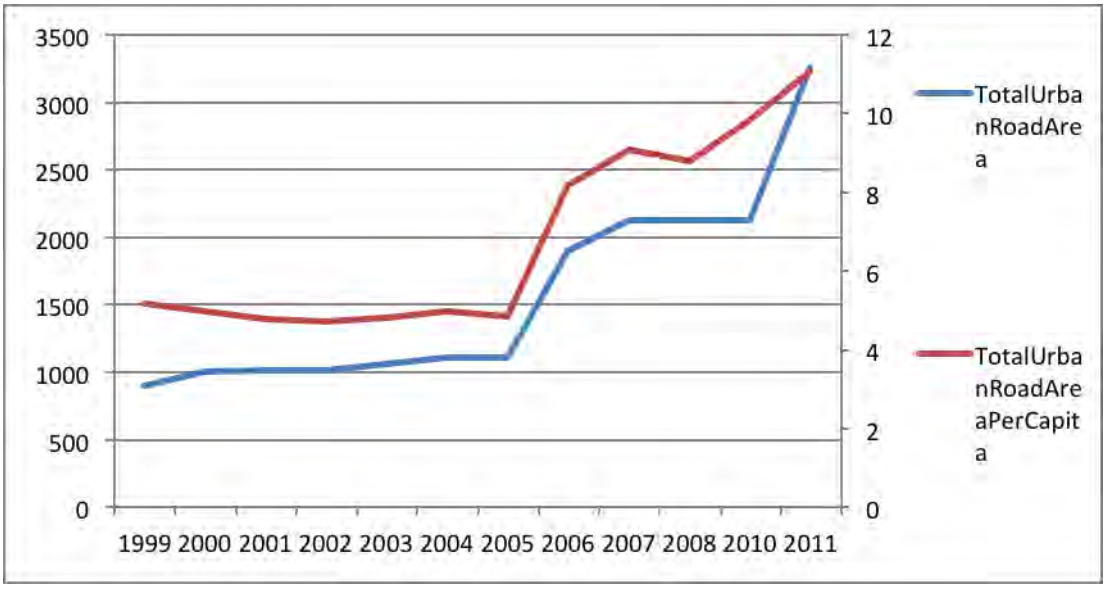


Fig-4.13 Urban Road Area

iii. Public transport

In the Kunming area there are no surface or underground railways. The main form of public transportation within the district is bus or taxi. As of 2011, there were 2,316 buses and 7,727 taxis registered in the city. The district database indicates that the number of bus passenger had increased from 29,310,000 in 2000 to 865,430,000 in 2011. Additionally, since December 2013, Kunming has started the construction of the city rail transportation system, consisting of a radial network of 6 lines. Until now, Kunming has completed subway line 1 and line 6, which have been put already into operation. The rapid development of public transportation made it more convenient for people to move around, and reflects the development of Kunming city.

iv. Intercity and international traffic

Kunming and other cities and countries become closer, it also reflected in the international traffic. The number of railway passengers is around 7,600,000. From 2002 to 2004 the number of passengers by air increased from 3,281,263 to 4,640,000, a variation of 41.4%. As many different ways in intercity and international traffic, the road traffic passengers decreased 12 million in recent 5 years.

v. Residential

Kunming urban residential land area increased from 49.83km2 in 2000 to 212km2 in 2009. Although data for 2007, 2010 and 2011 is unavailable, it is clear that residential land area increased during this period. Total real estate investment was 62.6 billion RMB in 2011, representing an increase of 42% from the previous year. Meanwhile, in 2014, the Central Committee also issued multiple policy planning, so Kunming's real estate industry still has a great development potential. The government stressed the concept of "City Group", building "City Circle" among qualified cities. Kunming and neighboring Qujing, Yuxi and Dali could group into a common development region, using and sharing common resources to improve infrastructure development, urban distribution, and real estate market.

4.3 Analysis and Conclusion

a. Kunming: Development potential and dilemmas

As the capital of Yunnan province, Kunming is a gateway city open to Southeast Asia and South Asia. And also, being an important tourist trade city, Kunming has good development prospects. The local government pays a high level of attention to its development and economic investment. But at the same time, there are problems to be solved in Kunming. Primary industry plays an increasingly dominant role in Kunming. At the same time, the city should simultaneously develop tertiary industry in order to promote the district's overall economic development. Along with economic development, Kunming faces environmental challenges. The poor quality of river water around urban and rural areas is especially concerning. According to the results from Kunming's major river water quality monitoring in recent years, pollution of rivers is quite serious and poses health risks, especially through relatively economically developed townships with dense populations. There are also serious problems with decreasing water volume. In the area of energy management, the government lacks the necessary capabilities for renewable energy management, a unified survey of renewable energy resources and development planning. Local energy resources such as biomass have not been fully exploited. The construction plan for the city also raises concerns. High density development around the city center has resulted in traffic and inner-city crowding. This style of urban development has also created unequal provision of social services favoring those in the center and underserving those in outlying areas.

b. Kunming development model and trends of sustainable urbanization

The development method of Kunming is the product form diversification and community function compound mode. City scope expands unceasingly and population is outward radiation. Urbanization is increasingly perfect. However, the speeding up stage of urbanization process follows the ecological destruction and environmental pollution acceleration phase. Pollution of the environment is an inevitable threat that urbanization face. So the government should build some environmental policy. Policy is like the implement cleaner production projects, strict environmental access systems, the construction project environmental assessments and energy assessments, and environmental protection, soil and water conservation, “Three Simultaneous” system, etc. Sustainable urbanization, therefore, need to an increase in urban population, the expansion of city and at the same time, strengthening the construction of infrastructure of traffic complex hydropower, science-education-culture-health social security following the demand of urbanization also need to be focus. Meanwhile, strengthening the construction of environmental protection laws, optimizing the structure of urban development and adjusting industrial layout should be paid more attention. To accelerate the transformation and upgrading Kunming vigorously promotes forestry secondary and tertiary industrial development, strives to achieve environment-friendly development pattern, and speeds up the development of ecological economic industry.

Annex 3: 4-City Database

QI Xiaoxu (RENDA)

This database is provided as a separate xls file. Please check link:
http://urbachina.hypotheses.org/files/2014/11/4-city-database-RENDA.xlsx

Sources:
Statistical Yearbook of the Provinces
China City Statistical Yearbook
Statistical Yearbook of China's Regional Economy
China Statistical Yearbook
China Environment Yearbook
China Energy Statistical Yearbook
China Urban Construction Yearbook

Scope:
Society
Economic
Environment
Resources & Energy
Infrastructure